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INTRODUCING THE CONTRIBUTORS

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POSSIBILITIES OF FUTURE TECHNOLOGIC DEVELOPMENT *

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With a subject as broad and inclusive as this, there is opportunity to ramble from the nucleus to the farthest galaxy and still stay within limits. In fact, the atomic scientists, arguing as they are so cogently for intelligent handling of the tremendous problem of atomic energy, may very well contend that if we do not have social control of the explosive fission of the atom, we might just as well start for that far-flung galaxy without further delay.

There is a terrific temptation to talk about only the material aspects of technology, about new plastics, new alloys, new foods, new textiles, new drugs, new electronics, and a thousand other new things that have blossomed during the war, although their roots are deep in the fruitful years of previous peace. I yield not to bigger and brighter bathtubs, dishes that you need not wash, automobiles that are speedier or even airplanes that travel faster than sound. Nevertheless, I am going to try to talk about the future because we may know something about the present and not like it too well. The future is always full of promise; we always believe it is our deliverance.

One can not view the future without seeing the present. The technologic future is born of the present and the past. We can control the future by what we do now or what we have done.

The technologic future is compounded of people, accumulated and accumulating knowledge, the raw and processed resources of the earth, and our modes of thinking and doing. You will note that there is not a $ in that statement. Dollars are not very useful or determining if you have enough of them. We, as a nation, seem to have a lot of them, perhaps too many of them.

We do not have enough of the right kinds of minds, enough answers to the inevitable questions that arise, enough of the fundamental building blocks of matter, or enough of the thoughts and ideas that are the essential catalysts of our civilization. I do not mean to imply that we are bankrupt as some deluded nations have been. We are simply striving for a higher standard of technologic living; we are far from subsisting on a sub-sustaining technologic diet.

We have done and are doing some foolish wasting and wanton destruction of the stuff of which the future must be made. The stupidness of Mars may be blamed for some of this but not all.

Take the priceless ingredient of the future, the human factor. Civilizations are what their populations make them. All men

* Address before Section K of the American Association for the Advancement of Science, St. Louis, Mo., March 27, 1946.

may have been created equal in the eyes of the law, but it is not undemocratic to point out that there are vast individual differences. I would have difficulty in setting this talk to music and my musical illiteracy is something that I would not deny if I were so charged. Some are great scientists and great engineers; others are great in other ways.

The fact is that the ability to do creative scientific research is rare indeed, although it may be more widespread than many have thought possible. An interest and ability in any phase of technology, science, medicine and allied fields is to be cherished.

Yet what did we do with this ability during the war and what are we doing now?

To those who think of the atomic bomb and the release of atomic energy as a God-given result of science, it may come as a shock to hear Dr. M. H. Trytten, director of the National Research Council's Office of Scientific Personnel, say, as he did at the Science Service Educational Conference of the Fifth Science Talent Search, that several hundred GIs, highly trained persons destined for overseas front line infantry duty, who were plucked from an assignment pool at a critical time, stood between success and failure of the Manhattan District project.

This is just a dramatic demonstration of how bull-headed pseudo-democracy that left technical personnel decisions to well-meaning but technically incompetent local draft boards has robbed us of thousands upon thousands of scientists and engineers of the future whom we sorely need at the present time. There is and will be for some time an appalling shortage of scientific manpower, thanks to such decisions at top and lower levels during the war. In some fields training was cut down as early as 1940. Progressively the flow of trained manpower in science was reduced, just when the greatest results of science applied to war were being rushed to the battlefields. Can it be that democracies, too, in their ignorance, have no need of scientists?

In view of the record, the military men might be expected to be the first to lift their voices of command against the virtual sabotaging of our scientific personnel strength. Research laboratories of the Army and Navy are not demobilized and contracted in size. Instead they are kept running and increased in scope.

Scientific manpower is being wasted in time of peace. Some of the most essential young men in the great war projects of the OSRD have been rescued from the postwar draft only with great difficulties. Some have been swallowed up ruthlessly in the postwar Army. Such is the gratefulness of our nation! Such is our national ignorance. Such is our unappreciation of whence comes our strength for recovery from war.

These civilian scientists out of uniform —virtual soldiers in work clothes—are evidently outside the pale. They get no GI educational rights, or veteran's hospital privileges, or colorful service ribbons, or the golden eagle that says: "I served." It is no minimization of the job that combat soldiers did, to say that fighting scientists in laboratory or field need fair treatment. They should not be penalized because they served so well in the capacity that they were best able to fill, and in the jobs that they alone could do.

This abuse and misuse of potential scientific manpower is continuing. Selective service boards in their eagerness to fill the ranks of occupation armies are snatching young men, regardless, when they reach 18. The war is won, and we have no need of doctors, engineers and scientists! That seems to be their attitude. The possibility of a science-talented young man getting to college promptly for training for great future usefulness is less promising in many cases than it was during the war. One of the winners of the Fifth Science Talent Search concluded earlier this month at-

tended the Science Talent Institute in Washington only by special dispensation from his draft board.

Even worse is the lack of any widespread serious effort to persuade science talented youth to do something about their potentialities in the interest of civilization. We are told that there is a shortage of 15,000 scientists in the land. This is far more serious than a shortage of sugar or wheat in the world, and it gets much less thought and attention.

As a consequence of the inaction in Congress upon the science foundation bills and because so much effort has been expended in trying to keep fundamental science out of the clutches of the military, this major problem of the continuing supply of scientific personnel has all but been neglected.

One argument is that the great flood of GI students now inundating the colleges will give us the raw material out of which scientists will be made. Figures show that this is simply not true. Veterans who have had the necessary preliminary training, interest and ability in science do not exist in sufficient numbers. The graduate schools, by and large, are not full in most sciences, in spite of extensive scholarship programs, in addition to the GI bill of rights, intended to get back into college the wartime research workers.

A great deal more must be done, and done immediately, upon the long and the short haul, if we are to have enough scientists in the future to do the needed fundamental basic research that must be government- and foundation-supported in non-commercial research laboratories, and to fill the beautiful and monumental research laboratories that industries are building in such magnificent profusion.

The very essence of our scientific continuity is contained in the stores of our accumulated scientific knowledge, whether these be in our libraries of technical and scientific literature, our patents, our secret war archives or the minds of men. War has mussed up the channels and disordered the files, and a major job in scientific and technologic reconversion is the bringing of all the modern methods we can devise to work upon this problem of scientific communication and intelligence. Scientific intelligence is fundamental to any planning of research in a broad sense. We need to apply microfilm, selecting devices, copying methods, and even radio to the problem of collecting, sorting, finding, distributing and using. Paramount is the necessity of putting a certain amount of scientific brainpower at work on this service activity. Because it will pay good dividends and apply the investments of research to technology and every-day living, it deserves the necessary millions of dollars. It should be tackled at the UNESCO level as well.

That man from Mars when he views the earth must be very puzzled by what men cherish in the way of earthy materials. He sees us storing up by the ton gold for which we have little practical use, aside from filling teeth. He sees us critically short of such prime essential materials as tin, lead, rubber, hemp, manganese and a host of other raw materials. We allow ourselves to be placed in a precarious hand-to-mouth position as the result of world economic intrigues, although it was pointed out long ago by our geologists and other scientists that we should stockpile what we are short of within our borders. Even in the postwar settlements, we are so unmindful of our technologic future that we do not get material, earthy, solid quid pro quo for our credits abroad, instead of chimerical paper credits likely to blow away in the next gust of world disagreement. We need a balance sheet of irreplaceable materials of our civilization and vigorous effort to get ourselves and our world neighbors in a good material position. This is a major, immediate job.

Ideas and modes of thinking are so important in science, technology and everything else we do that we may take them for granted. Human nature is the root of all

good and evil. It makes wars and peaceful living.

Mathematics occupies its key place in science because it is a manner of thinking. The human brain guiding a stub of pencil on a scrap of paper (supplemented or not by an electronic computing machine) can do things that brute strength could never achieve.

Scientific thinking is useful outside the laboratory. To the extent that it is used in world relations, government, industry and other human affairs there will be more peaceful living.

But do not for a microsecond imagine that scientific thinking is all harsh, blunt, unemotional and uninvolved. The processes of human thought are not yet charted and logically understandable. The formulae can not yet be written.

Part of the troubles of the world come from the stern logical approach to human affairs. We need psychologists and psychiatrists, as well as economists and atomic physicists, to guide our statesmen in their dealings with themselves and others.

About a year ago two thousand American psychologists issued a statement on "Human Nature and the Peace." Here are some of the things they told us: War is not unavoidable, since it is built into men, not born in men. To build peace, work with the rising generation. Hatreds, racial, national and group, can, to a considerable extent be controlled. Condescension toward "inferior" groups destroys our chance for a lasting peace. Liberated and enemy peoples must participate in planning their own destiny. The man in the street knows the general directions in which he wishes to progress and his expressed aspirations should be a major guide to policy.

Such fundamentals are just as much science as the laws of the fission of plutonium. The basic principles of human nature, whether exemplified in British, Russian or American, can be studied and, to a degree, understood as a guide to getting along without conflict. This is a study potentially as important as any other research project in the world. It may allow the avoidance of more death and destruction than any other human activity if we can understand and act sufficiently fast and positively upon what is known and can be learned.

While we talk of world affairs, we could use a considerable amount of understanding of human nature close to home in order to avoid labor-industry conflicts, race prejudice, and economic and political intolerance.

This whole intricate human nature problem is one of the least explored areas of science. There are many unworked fields in the scientific landscape. Some of them, like human relations, are fenced in by taboos and customs. Others are neglected. Our scientific research as a whole is so unplanned and distressingly laissez-faire.

A great deal can be said in favor of planning, if it is the right sort of planning. True, a dictator makes plans, and that kind of planning for science can stifle progress and oppress the scientists. What is needed is the kind of planning that points out the opportunities and sets up challenging problems. Attempts to set up problems would expose further needed researches. Adequate planning would also include the means and personnel for realizing the opportunities.

That is where S.1850 and S.1717 come into the science picture of the moment. These bills before Congress contain much of the hope for a vigorous support and utilization of science in the interests of the people in a peacetime world. The National Science Foundation bill (S.1850) provides the organization and the sinews to carry on basic scientific research in universities and non-commercial laboratories. Such knowledge will bring forth technological advances of the future. It can implement the information services needed by science and technology. It would cherish and nurture our science talent so

sorely needed. The McMahon atomic energy bill (S.1717), if the military clique had not ruined it, would have made possible proper controls of energy from within the atom, and would have restored the possibility of the continuance of nuclear research, now virtually hamstrung by non-understanding secrecy imposed by the military. The science and atom bills are the most important measures before Congress so far as our future is concerned.

If Congress enacts them without disabling mutilation and without undue delay we may be able to counter the precipitous demobilization of research that followed upon the end of the war. We may be able to get key scientists back to work exploring atomic nuclei. We may avert the tragedy of science misused as a mad challenge to a new world war. But it is later than it seems. Time and science refuse to wait around for uncomprehending obstructionists.

These thing I talk about are such general objectives for technologic development, you are saying, You are interested in things that factories can do tomorrow or next year. Go to the Patent Office or to the bright young men of the developmental laboratories of our great corporations, who are working with the fundamental ideas of before the war, twisting them into intriguing appeal and possible usefulness to the people. The real future for technology is contained in the fundamental science of today and tomorrow, the discoveries and observations that we can not guess as to what they are or who will make them. We only know that they will be made if our researches are sufficiently wide-flung, mobile and discerning.

The scope of all knowledge and the wide range of human thought constitute the basic foundations of future technology. I suppose that the manufacturers of castor oil, calomel and spring tonics before the First World War could hardly have been expected to foresee what an industry the manufacture of vitamins has become.

So I list a few of the blind spots in man's knowledge, a few unknowns worthy of our most skillful and energetic probings. All of them are stuff of the future.

Here are intensely *personal* unknowns:

1. *Living longer:* the prolongation of life, the retarding of old age, the prevention of premature senility, which means the conquest of degenerative diseases, among them cancer, heart and circulatory disorders, nephritis, arthritis, and diseases of the respiratory system and the brain. We should be able to live and work a half generation longer.

2. *Virus conquests:* least controlled of all infectious diseases those caused by viruses, such as colds, poliomyelitis, need their nemeses, their sulfas and antibiotics.

3. *Healthier personalities:* mental ills, ranging from chronic grouches to disabling psychoses, take major tolls. Disordered personalities have physical, mental and emotional bases. Mentally warped personalities give rise to crimes against society, including making of wars.

These are concerned with the discovery of the substance of the universe:

4. *Exploration of the elements:* new chemical elements are still to be discovered, probably a half dozen or so. Transmutations (not alone of uranium) and properties of older ones need exploration. Undiscovered sources should be sought for elements little-used because scarce. Particles within the atomic nucleus yet unidentified may exist.

5. *Exploration of the universe:* the impact of astrophysical knowledge of the universe around us may be more philosophical or religious than technologic, but sun, stars and galaxies have their down-to-earth effects. Experiments of immense time and size are in progress.

And here are a few major scientific mysteries:

6. *The secret of photosynthesis:* despite the energy released from within two atomic nuclei, our main source of energy is the sun, whose radiation is converted

by photosynthesis in growing plants, a process we do not understand and can not duplicate in any factory.

7. *The secret of protoplasm:* the living cell is the seat of life itself. An explanation of its protoplasm may explain life. Nuclear chemistry of the living cell may be more revealing than nuclear chemistry of the elements.

These concern in great degree the world community:

8. *Automatism:* the lever, wheel and such simple devices were beginnings; steam, electrical and internal combusion engines were further steps; the electron tube is the prime servant of automatic operation today, peaking in complex electronic computing machines that almost think in a routine way. Automatic operation applied to factory, farm and home, assuming the burden of human druges, may give time for more creative thinking and doing.

9. *World brain:* civilization's memory is in its records, its books, its literature, its handed-down lore and customs. Overburdened human brains forget. Our world organization or disorganization of knowledge has its lapses of incomplete records, its Babel of languages, its geographical stagnation, its confusion of classification and its overpowering bulk. The intelligence of the world may be intelligent enough to mobolize for use its intelligence.

10. *Psychological welfare:* in the stress of war, all the skill of psychological interpretation (propoganda, if you will) and all the machinery of mass communication are devoted to world-wide mutual understanding (of our side). This psychological warfare needs to become peaceful psychological welfare, a process of peoples knowing and understanding within and across man-made borders. This will be the essence of peace, which history shows is one of the greatest of unknowns, worthy of the most intense and earnest scientific research.

SCIENCE TEACHING AND INDUSTRY *

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Two short years ago we were engaged in a war unparalleled in history. At that time the Industry of the United States was producing 40 per cent of the total world production. The other 60 per cent included not only our allies, England, Russia, and the rest, but also our enemies, Germany and Japan. Our production consisted primarily of airplanes, tanks, warships, trucks, guns, rockets, radios, radars, and atomic bombs. All of these were highly complicated scientific tools which had been designed, produced, assembled, and tested by our American workmen, both men and women—young and old—that is, those who were not in the Army and Navy. These complex, technical tools of war were used by boys with a training of only nine to eighteen months. The ability of the farm and city boys of our country to assimilate the training in so short a time and to develop into the finest fighting team the world has ever known, is a tribute to the quality of science teaching in our schools which goes far beyond any formal certificate that might be prepared.

And now we face a post-war industrial boom, where again it will be difficult to meet the production demands of our own people for consumer goods and the re-

* Address before the Science and Mathematics Section in connection with the March, 1946, St. Louis Convention of the A.A.A.S.

quirements of the rest of the world for capital goods as well as for food and seed. The war production was accomplished with large use of power. It amounted to more than 6 horsepower-hours of electrical energy per man-hour of industrial work. This is more than twice the power used in Germany before the war and more than 10 times the power used in Japan. Using large amounts of power, it is possible to produce with only 1000 workers a tonnage of synthetic rubber equivalent to the amount of natural rubber normally produced from 28 million trees and with a labor force of 40,000 workers. This is typical of modern production miracles. By these advanced technological methods industry hopes to produce " more goods for more people at less cost." But all of these production methods require a high degree of technical or scientific training. Even the housewife may find a considerable degree of scientific understanding useful in manipulating the dishwashers, automatic laundry devices, refrigerators, and ranges of the future.

With such a background it is not necessary for me to tell you that industry is interested in the scientific training of our young people. It is already evident that a scientific knowledge is necessary not only in our research, design, production and engineering departments, but also is very valuable if not absolutely necessary for people in the sales, accounting, and advertising departments as well.

In this connection, let me say that science is particularly useful in developing a habit of straight thinking which is so badly needed at the present time. The students must in addition, however, have an opportunity to practice this straight thinking under adequate guidance in the fields of economics and sociology. And so as science teachers, you should not underestimate the importance of sound instruction in these fields. You should, in fact, encourage students with science interests to give serious attention to the social studies.

But to return to our primary interest—you undoubtedly are aware of the shortage of engineers which has been estimated to be about 50,000. Similar shortages exist in the other fields of science, such as physics, chemistry, biology, and so forth. Our young men have been fighting a war instead of preparing for advanced work in the fields of science. Under such conditions the interest of industry in scientific instruction in the schools is, I repeat, self evident.

Interest, however, is of two different types. One type is passive, and in that case the person or industry desires information and data on the subject, but does nothing to influence the situation. The other type of interest is active, and in this case the person or industry not only obtains the information, but attempts to influence or change the situation. General Electric Company has always pioneered in this type of interest in scientific education. For a period of more than 25 years they have had a special department to serve the engineering colleges, since these colleges were their special interest in the field of scientific education. They regularly arranged for professors to spend summers and sabbatical leaves working as practicing engineers in the factory. They organized summer conferences of engineering professors where these educators were housed together, worked in the various engineering departments, and held regular discussions both during working hours and after hours. They also designed special laboratory equipment so that the teachers would have improved tools of instruction. They supplied pictures of outstanding equipment and of manufacturing methods to motivate student interest. They likewise supplied scientific bulletins describing many of these newer developments. And gradually their interest expanded to include the field of high school science.

As a result of this active interest in

science education, not only by our own company but also many other companies, the high school science teachers now have many valuable teaching aids available to them. Among these are poster services such as the Photo-News Service, and free bulletins. These free bulletins range in level from the lowly comic book which assists in student motivation, through the simple scientific bulletins such as the simplified explanations of vacuum tube operation, to the highly scientific bulletins put out by the Research Laboratory. The extent to which these helps can be used to advantage will depend somewhat upon the scientific background of the teacher. He or she must be able to interpret and clarify the material presented to the student. Much improvement in the level of scientific training may be expected from the improved character of instruction for science teachers that has been proposed by Dr. K. Lark-Horovitz and Dr. H. A. Webb.

In 1928 the General Electric Company pioneered in providing another type of teaching aid. This was the educational sound film made by Dr. Irving Langmuir entitled "Oil Films on Water" and is well known to many of you. Some industrial organizations have felt that, to justify the expense of making these movies, it was necessary to include some advertising, and the resulting tendency of advertising to encroach on the real objective of the film has occasionally limited their usefulness. Since we believe in the efficiency of the teaching methods described by Dr. Schorling, we are continuing to prepare educational movies which we hope will correct most of the past difficulties and will prove to be increasingly useful in your educational program. The latest one in our library is entitled, "Principles of Electricity" and has been well received.

These are teaching aids, and as Dr. Schorling indicated, it was the extensive use of teaching aids which made the War Training Methods so effective. The General Electric Company, however, has always believed that the key to good instruction was the teacher. As I have already said, the Company's main activity in assisting engineering education was directed toward broadening the experience of and providing new stimulation for the teachers.

Recognizing the importance of science instruction in the secondary schools, they have again pioneered in this "active interest" in science instruction. I refer to the special course of instruction for high school science teachers which was started last summer and is being enlarged this coming summer.

This particular program is, I believe, worthy of a brief description as it appeared to be a most successful experiment. Thirty-eight selected teachers of high school physics from seven states of the northeastern section of the country were brought to Union College at Schenectady on fellowships of the G.E. They received courses in modern physics, electronics, and laboratory methods All those in attendance were experienced teachers, so no attempt was made to give them any instruction in teaching methods. The Union College faculty and the lecturers simply tried to teach them *physics*. Many of the lectures were given by scientists from our Research Laboratory, who were specialists in the particular field being covered. Dr. V. Rojansky, Professor of Physics at Union College, however, provided the connecting material to make the program a coherent whole. At first there were some quite worried members of the class, for example when Dr. Saul Dushman of our Research Laboratory lectured on modern physics. Their calculus was so rusty as to be almost useless, they were unfamiliar with the terminology of modern physics, and the pace was just too fast. So, the faculty slowed down the pace, the teachers began to limber up their calculus, gradually became familiar with the terminology, and by the end of the program there was unanimous agreement that much had been learned.

One feature of the program that proved to be especially popular was a series of carefully planned inspection trips to the Research and General Engineering Laboratories. This provided a great deal of stimulation and showed the teachers how science was really used in the work-a-day world.

Only a limited number of these teachers applied for graduate credit as the reduction of the level of instruction justified credit only for those who were in the upper portion of the class.

The success of the program is best illustrated by a letter received this past winter in which one of the teachers reported that he had accelerated his physics course somewhat in order to get in some material on electronics. Very much to his surprise, he was able to get better understanding at the accelerated pace than he had previously obtained at the slower rate. He incidentally reported that he had made no attempt to accelerate his chemistry program, but at the end of the term found himself two weeks ahead of schedule, with better comprehension than previously obtained. An individual report is of course not conclusive, but the tone of other reports received have been quite similar.

This summer the program is being enlarged. Fifty teachers, all of whom are expecting to continue in high school work, will be selected from the Northeastern section of the country, and provided with scholarships which will pay for travel expense, room, board, and tuition. These fellowships will be equally divided between the fields of Physics and Chemistry. All lecture and class work will be common for both groups, but some differentiation will be made in the laboratory program.

But you say, the General Electric can reach only a few of the many thousand physics teachers in our high schools each year. True, but it is an experiment tried and found successful. Are there not schools and industries in your state that could set up a similar program? Possibly not in physics, but maybe in biology, or chemistry, or botany or some other phase of science. If it were possible to run one or two such programs in each state for a period of five years, would it not revitalize the teaching of science in our country?

INDIVIDUALIZED INSTRUCTION IN A BASIC SCIENCE COURSE

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I. CHARACTERISTICS OF INDIVIDUALIZED INSTRUCTION

Many systems of individualized instruction have been tried since the pioneer work of Search in 1888. These all have involved (1) assignments covering a relatively long period of time, (2) provision for students proceeding at different rates according to ability, (3) use of a wide variety of materials in and out of the classroom, (4) lessened emphasis on formal lectures and recitations, and (5) the teacher acting as subject-matter counselor rather than drillmaster.* These systems have met with a mixed reception, but generally have been better received in elementary and high schools than in colleges.

Individualized procedures have generally been referred to in educational circles as laboratory techniques. This is somewhat at variance with the accepted definition of laboratory work in science. Originally

* Briggs and others. *Laboratory Techniques of Teaching.* Bureau of Publications, Teachers College, Columbia University, New York, 1938.

the science laboratory, even for beginning students, was a place of problem-solving and research. Laboratory work has tended to degenerate, however, into a kind of "cook-book" procedure, in which the student follows instructions, and obtains a cut-and-dried result. In organizing an individualized program for a basic science course, it is necessary to return to the original concept of laboratory work as a problem-solving technique.

This involves broadening the definition of laboratory work to include the use of books, films, recordings, interviews with authorities, field trips, surveys and other sources of information utilizable by the student in the pursuit of significant problems. Even discussion groups, when elected by the student as a worthwhile source of information, may be considered as a kind of laboratory experience. These sources should be thought of as supplementing observations, demonstrations and experiments, however, rather than replacing them.

II. EXPERIMENTATION WITH INDIVIDUALIZED TECHNIQUES

During the past eight years the writer has experimented extensively with individualized methods in the teaching of the general biology course at Stephens College. Both project-type units and small-group units have been used, and the students have been given a relatively wide range of choice in their selection of activities.

It is obvious of course that there are certain ideas or principles in the field of biology which must be learned, no matter what specific experiences or means of approach are used. To achieve this purpose when students work on different topics requires careful planning. This was cared for by (1) defining a limited number of subject-matter areas, in each of which students are required to do some approved work, (2) developing a set of principles or basic ideas toward the acquisition of which this required work should be directed, and (3) preparing lists of experiences from which students can select units of work to fulfill this requirement.

Eight areas were set up as a result of a research study * on the science content of periodicals designed for laymen, and the kinds of projects selected by students. These were (1) Animals and plants, (2) Food, (3) Body form and function, (4) Reproduction and development, (5) Health and disease, (6) Man's activities, (7) Man's uses of materials, and (8) Science and man's thinking. The required work in each area may take the form of either an individual project or a group experience, provided it leads the student toward an understanding of the desired principles and ideas. The remainder of the work is elective, and may be concentrated in one or more of the eight areas. An individual's program may emphasize either projects or group experiences, but always includes some of both.

In all activities the approach is problem-centered. During the development of the course the procedure has been consistently experimental, with new ideas being tried each year, and those which proved workable being retained as permanent features. In the early stages of experimentation projects based on students' needs and interests were used almost exclusively as the medium of instruction after a brief introductory period of group work. In connection with these projects a number of questions arose. Where should a student begin? How much should be required in the way of prerequisites for the study of a particular topic? To what extent should a student's work be planned for her? Should certain references be designated, or should she look up her own material? Should all students working on a topic cover the same ground, or should individuals be allowed rather wide latitude?

The answers to these questions were

* W. C. Van Deventer. "Organization of a Basic Science Course." SCIENCE EDUCATION, 30: 201–206, October, 1946.

worked out through a gradual evolution in the direction of greater freedom of treatment. Originally a system of project sequences was set up, with requirement of definite prerequisites for dealing with most topics. Thus a student wishing to study tuberculosis was first required to study the anatomy and physiology of the respiratory organs, the nature of disease-producing microorganisms and the body's defenses against them. All students were required to follow project outlines, which included reference readings and other experiences, and the items to be dealt with in the reports.

This rigid system has now been abandoned. It has been found possible to begin a study of most topics at other than the traditional starting points. This permits the use of a psychological rather than a logical approach, and increases student motivation. Several different kinds of projects have been developed. A single subject-matter unit, such as habit-forming drugs, may be surveyed briefly, or it may be broken up into several projects such as: Narcotics, marihuana, alcohol and tobacco. These may be done as a series, or only one may be used. The completion of one project in an area may lead to another on a related topic. Thus a project on evolution may lead to one on the nature and origin of life, or science and religion. In a very few areas, such as heredity, it has been found necessary to follow a kind of sequence. Thus a student wishing to study heredity in relation to mental traits is usually asked first to review a book on heredity in general, written at the layman's level, or to become familiar with the basic principles of heredity.

Another type of project involves principally activities. Such projects are available in nearly all areas. They include surveying the incidence of colds in residence halls, measuring the heads of students of different nationalities and calculating cephalic indices, working out the relationship of heredity and environment in determining height, collecting biological materials in the field and constructing balanced aquaria, reproducing plants from cuttings with the use of root hormone, germinating seeds in different kinds of soil, conducting diet experiments with laboratory rats, preparing skeletons and animal skins, experimenting with primitive vegetable dyes, testing different kinds of textile fibers, and surveying the public health agencies at work in a town. Sometimes these projects are undertaken by individuals, and sometimes by small groups or committees.

Students are asked to prepare a separate bibliography for each project. This is turned in with the project report, and is filed for future use. Thus an extensive set of bibliographic materials has been built up, including references to books, current and bound periodicals, and processes used in activity-type projects. The science library is located near the laboratory, and the librarian aids the students in planning projects and locating materials.*

As the course has evolved, the program of group experiences has been added to the project system. All are elective, except for a few at the beginning of the year in connection with the introductory period. They include microscopic work, dissections, demonstrations, laboratory-demonstration combinations, motion pictures, field trips, recordings and group discussions. In each, an attempt is made to emphasize broad aspects, and to leave room for individuals to stress those features which they find most significant. Students are given a range of selection among related topics in group discussions, and the trend of the discussion is set by their questions. Likewise with motion pictures, recordings, field trips and demonstrations they are asked to include in their reports those features which were most significant for them. Parallel

* The writer wishes to express appreciation to Miss Molete Morelock, science librarian, whose cooperation has greatly aided in the development of the individualized program.

readings are assigned in connection with most group experiences, and are treated in the same way. In all cases the emphasis is on doing, observing, listening and discussing, activities which are student-centered rather than teacher-centered.

III. ADMINISTERING AN INDIVIDUALIZED COURSE

Administering a program of this type depends to a great extent on the development of student responsibility. Therefore the introductory unit of two to three weeks at the beginning of the first semester is used as a "warming-up" period, during which the student gains some familiarity with the materials and methods of the course. Readings are assigned and discussions are conducted concerning the contents of the various subject-matter areas, and the mechanics of the individualized procedure. During this time, also, all students are given a set of basic experiences involving the use of the microscope and the study of animal-plant communities.

At the end of this period each student is asked to plan a tentative program of projects and group activities based on her needs and interests. This may be altered later as a result of changed conditions or additional information. The requirement that it contain approved work in each subject-matter area, however, is rigidly adhered to. This program is checked for consistency and completeness, but no major changes are made without consultation with the student.

During the remainder of the year each individual carries out the work that she has planned. Usually two or three group experiences are scheduled each week. Students attend those which they have elected, and may attend others also, at the same time that they are working on their projects. The general program of group activities follows the order of the eight subject-matter areas. Those which a student attends may or may not be related to the project on which she is working, but they bear a general relationship to her total project program.

Weekly programs of group activities are posted on the bulletin board. A meeting of all students in each section is held once every two weeks to check on progress with projects. The science librarian frequently attends these meetings as a consultant. Students are required to see the instructor at least once in each alternate week. Much of the remainder of the time is spent in conference with the instructor and the librarian.

The objection is frequently raised that a system of this kind is unduly demanding of the teacher's time. In actual practice this does not prove true. It requires careful planning and is facilitated by the use of mimeographed materials which can be prepared in advance, together with bulletin boards, notes in student call boxes and other means of communication. After having used both this system and the traditional lecture-laboratory method of science teaching for a number of years the writer is convinced that the individualized approach is no more time-consuming, and because of its highly variable character, is actually less productive of fatigue.

IV. EVALUATION OF STUDENT ACHIEVEMENT

Because of the varied nature of the learning experiences, reports generally take the place of tests as instruments of evaluation. Oral or "practical" tests are used in the case of dissections, and any students who prefer tests instead of making reports on other units may request them. Reports may be of essay or outline type, or they may take the form of a summary listing of "What I did" and "What I learned." As far as possible, students are allowed to use whatever type of report is best suited to them and their work.

Students are encouraged to develop the concept of "earning" a grade rather than having a grade "given" them. Grades depend on both quantity and quality of

work, and are awarded on the basis of a point system. Students earn points by attending and reporting on group experiences, and by doing projects. The relative point values of projects and group work are so balanced that no one will attempt to earn a grade by doing either exclusively. This system of grading allows maximum opportunity for the student to determine her own level of achievement, and to get from the course a value comparable to the effort that she puts into it.

A folder is maintained for each individual. It includes (1) a running record kept by the student of the projects on which she is working, (2) a grade record kept by the instructor of the number of points earned in connection with projects and group experiences, and (3) the student's planned program of activities. Graded work is organized into a notebook at the end of the semester. This requires an over-all view of the course, and serves as a summing up of the semester's work.

Serious consideration has been given to the use of standard evaluation instruments. Although factual tests based on the units actually completed in the course have been used for several years, it is apparent that some more effective kind of group evaluation should be devised. Tests based exclusively on knowledge of subject-matter are of limited value because of the wide variety of work done. However the students' understanding of basic principles and ideas could certainly be evaluated, since these may be derived from a variety of subject-matter experiences. Students may also be expected to develop a relatively homogeneous core of attitudes which could be tested.

Recently a feeling has grown that a new type of test might be helpful. In this the student would be evaluated on the basis of what she feels she has gotten out of the course rather than what the instructor thinks she should have gotten out of it. This test should include basic principles, ideas, attitudes, interests, breadth of concepts, library skills and general knowledge. The development of an adequate group testing program should constitute the next step in the evolution of the course.

V. SUMMARY

1. Individualized instruction implies that students will use a research approach in dealing with problems of real significance for them. It also involves a broadened conception of what laboratory work includes.

2. By experimentation, a basic science course has been evolved in which the student is brought to an understanding of certain fundamental ideas or principles in each subject-matter area, even though she is permitted a wide range of choice among a variety of projects and group experiences on the basis of her needs and interests.

3. As far as possible activities are designed to be student-centered rather than teacher-centered, and in all learning experiences students are permitted to emphasize the features most significant for them.

4. This program is not more time-consuming than the traditional lecture-laboratory method of teaching, and because of its variety is actually less productive of fatigue.

5. Evaluation is largely on the basis of written reports, and grades include both quantity and quality of work. There is need, however, for a group evaluation instrument which will test for a wide variety of student attainments.

THE CLIMATES OF THE UNITED STATES

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CHIEF CLIMATIC REGIONS

The Continental Climates

ALTHOUGH the climatic diversity of the United States is great, most of the country consists of one or another of the several subtypes of one major climatic type, the Continental. This type is characterized by well-marked temperature seasons, which are responses to the fact that most of the country is situated in middle latitudes, 30°–49° from the equator, in the interior of a large continent, with mountain ranges near the western and eastern coasts, which mountains reduce the penetration of oceanic influences. The well-marked seasons result from the sharp change in the height of the noonday sun (47° between the solstices) and in the length of day (4 hours and 42 minutes between the solstices at latitude 40°, and about 8 hours at the 49th parallels).

The approximately three-fourths of the United States which has Continental Climate displays gradual variation with latitude, and often is subdivided into a warmer, a cooler, and an intermediate zone. It also varies in precipitation. Subdivisions based on contrasts in precipitation which are often recognized are humid, arid, and the intermediate semi-arid. Sometimes a fourth type is recognized, the subhumid, transitional between the humid and semi-arid.

Although the precipitation zones commonly recognized are based chiefly upon the annual average totals received, various other precipitation conditions are highly significant, including form (rain, snow, sleet, hail, glaze), and dependability or variability.

In addition to the subdivisions of the Continental Climate due to contrasts in temperature and in precipitation, there are zones of sunshine, which differ appreciably from those of temperature, and zones of atmospheric humidity and fog, which are not nearly identical with the precipitation zones. Zones based on winds are also significant, although less clearly evident than are the zones on the oceans of the planetary winds known as the Trades and Westerlies and the belts of "calm" between. In the Continental Climate part of the United States, wind zones, despite their vagueness, introduce notable complications. Of particular importance are the zones of variation in the frequency of various types of wind storms, including the cyclonic Lows, thunderstorms, tornadoes, and tropical cyclones.

With the superimposition within the Continental Climate of these several types of zones, it follows that a considerable number of climatic subdivisions are logical, and have been made by various persons delimiting the climatic subdivisions.

Nevertheless, the changes within the Continental Climatic Region are almost all so gradual that comparative uniformity of conditions, rather than diversity, often prevails. For example it repeatedly happens that much of the vast continental interior is comparatively warm for the season or cold, or wet or dry. Likewise, the entire region is subject to frequent changes of weather, and to the same types of storms, although not to the same degree. This comparative uniformity, is however, far less real than most people believe, as a study of climatic maps reveal.

Within the Continental region, the mountains introduce a conspicuous complication. Three types of mountain climates are easily recognized although intergradation occurs. These are the wet mountains, the dry mountains, and the high mountains. The

Appalachians are wet mountains and are forested, the ranges in the Great Basin are dry mountains as are the dry side of the Sierras and Cascades, and most of the Rockies. The Rockies seemed bare to those who named them. The high mountains are those parts which are snowcovered all or most of the year. These three mountain types notably increase the country's diversity, perhaps especially its recreational riches.

The Coastal Climates

Bordering the various continental climates there are four coastal climatic types which are readily recognized. The most distinctive ones are on the Pacific Coast. The dry subtropical, California, or Mediterranean type extends north nearly to the 40th parallel, and east to the Coast Ranges, and in a modified form it extends eastward to the foothills of the Sierra Nevadas.

The California type of climate is characterized by mild, rainy, but rather sunny winters and hot, dry, almost cloudless summers. Adjacent to the ocean, the summer heat is tempered by sea breezes, and often by fog. At high elevations, and much of California is elevated, the summer heat often is tempered by nocturnal cooling, and occasionally the summer drouth is broken by showers. It should be emphasized that less than one-fourth of California has the California type of climate, and that in more than a fourth of the state this type is lacking. About half of California has a climate transitional between the California type and the Arid Continental or the Marine.

The Marine or Oregon type of climate is found in western Oregon and Washington, west of the Cascades, and most typically west of the Coast Ranges. It is characterized by mild winters and moderate summers. Rainfall is heavy in winter, and rather abundant in spring and autumn, but is inadequate or even lacking in midsummer. This type of climate is the most temperate in the United States, sharply contrasting with the Continental type. The winters are cloudy, often dreary despite their mildness. The Oregon type of climate closely resembles that of the British Isles, and is exceptionally healthful, as revealed by the comparatively abundant energy of the people and their generally rather ruddy complexions. Because of the mountains only a small part of the states of Washington and Oregon have this climatic type. Just east of the Coast Ranges, notably of the northern, snowcapped Olympics part, there is relatively little rainfall (less than 25 inches per year in some places), and warmer spells often occur in the dry summer. East of the Cascade Mountains, the climate is Continental, except that some marine influence penetrates the Columbia River Gap.

On the east coast north of the 40th parallel, the continental influences are commonly borne even out to sea by the prevailing westerly winds. Hence some experts do not recognize a coastal type of climate in that region. However close to the sea, winter temperatures average notably milder and summer temperatures less hot than occur inland even a short distance. Various other departures from the characteristic of the cooler humid Continental type also occur; for example on the coast there is much less snowfall and snow covers the ground only briefly. Whittier's "Snowbound" describes the interior of New England, not the littoral.

On the southern Atlantic Coast, and extending westward near the Gulf of Mexico to southeastern Texas, is another climatic type which differs significantly from the Continental. This is sometimes known as the Humid Subtropical, the Mild East Coast, or the Modified Monsoonal type. Here it is sometimes called the Carolina type, because the eastern parts of North and South Carolina have it. It is characterized by rainfall throughout the year, by hot summers which are made relatively enervating by high humidity, and by generally mild winters, during which, how-

ever, real cold spells occur occasionally. The masses of cold air from the continental interior, including Canada, often sweep to the Coast; and even northern Florida occasionally experiences subzero temperatures, while other southern states have had more than 10° below zero, not far from the coast. These "cold waves" while distressingly frequent from the standpoint of agriculture, notably the growing of early crops for the northern market, are not sufficiently frequent to make this a stimulating climate. Indeed much evidence indicates that it is less well adapted to the development of civilization than any other American climate. Two other unfavorable aspects, in addition to the humid heat of summer and the general lack of stimulating changes of temperature, are the abundance of torrential rains, which have caused much leaching of the soil, and serious soil erosion on sloping land. The presence of more severe storms than is characteristic of any other American climate is another unfavorable aspect. The most numerous of these storms is the thunderstorm, which here surpass in average intensity and frequency those of the other American climates; tornadoes are more numerous than in three-fourths of the country, and tropical cyclones cause much more damage in this climate than elsewhere in the United States.

OPPORTUNITIES FOR WOMEN IN CHEMISTRY *

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IN 1939, the Division of Chemical Education of the American Chemical Society at its Boston meeting sponsored a Symposium on Training and Opportunities for Women in Chemistry. Briefly, the discussion showed that the girl intent on using her training in chemistry before 1939 had found it necessary to turn to borderline occupations as shown by the following tabulation:

High school teaching	16.1%
Medical technician	14.6%
Study	17.4%
Marriage	13.6%
Non-technical interests	80.0%

Less than 5% were listed as engaged in industrial research; 4.7% as industrial technicians; and 4.8% in library work and positions as chemical secretaries. From these figures, we have to admit that woman's place in the industrial chemical world before World War II was small and none too secure.

Back in 1922, the Bureau of Vocational Information made a study of "Women in Chemistry" which was published in book form. Charles Herty wrote the introduction which he concluded as follows:

> "For the college woman about to choose an occupation, there is presented here a comprehensive, conservative description of existing conditions, interspersed with sage advice as to the difficulties to be encountered."

In this study, we also find that the number of women chemists as far back as 1920 approximated 4 to 5%. However, of the one hundred thirty-four doctorates in chemistry conferred in 1921, thirteen were conferred on women. This was 9.7% of the whole number showing that women were securing superior training despite the "difficulties to be encountered" in finding a job.

In "Your Future in Chemistry" from the American Job Series of Science Research Associates (1943), we learn

> "The chemical industry has been growing rapidly for many years. In 1910, there were only 16,273 chemists listed by the U. S. Bureau of Census. By 1920, this number had increased to 47,068 and by 1940 to 53,440. These figures do not include teachers of chemistry, chemical engi-

* Delivered before a regional meeting of the American Chemical Society, Austin, Texas, December, 1945.

neers, nor those who combine chemistry with other occupations, nor the many thousands of workers who serve in other capacitles in chemical industries. There are about 5,300 teachers of chemistry and chemical engineers who teach chemistry in one hundred eighteen universities and colleges. The Federal Government employs some 2,000 chemists in normal times while the states and territories have about 750 chemists working in experiment stations or executive departments."

Women entered the chemical field during World War I. Before World War II, about 4% of the chemists were women. Their work was largely in the fields of biochemistry, food, nutrition, cosmetics, and certain divisions of textile chemistry. They also combined chemistry with other subjects and became librarians, translators, literature abstractors, editorial workers, teachers, and office assistants to chemical executives. City, State, and Federal Governments employed large number of women in their departments of education, health, sanitation, and in home economics.

The entry of the United States into World War II changed employment conditions, but a Hogg Foundation lecturer speaking to a group of high school girls told of a chemical concern employing 100 women in contrast to 12 before the war, but in the postwar period would replace or release them as fast as practicable. Competition is going to be keen and women will have to give of their best to survive. They will continue to hold those laboratory positions in industry which do not require heavy work, but unless a woman is unexpectedly brilliant in industrial research, her greatest opportunity will more likely be in combination with other subjects. Of course the field of teaching chemistry is always open to her. Fortunately, there are occupations which combine chemistry with other subjects; such as chemistry and writing or chemistry and art where women could be advantageously employed in the advertising end of some chemical industry.

In " Opportunities for Chemists in Literature Service Work," (*Journal of Chemical Education,* 21:315–318, 1944) we find these opportunities and responsibilities listed:

(1) Reference work
(2) Abstracting and indexing
(3) Bibliographical work
(4) Patent searching
(5) Translating
(6) Editing and writing

One seldom thinks of a person surrounded by books as being a chemist. Laboratory chemists surrounded by test tubes are very likely to designate them " graphite and cellulose chemists," but the work they do is important to industrial research, for research must be revealed in a clear, concise, and convincing manner. Before the war women had a monopoly on this kind of work, and it is safe to predict that this will continue to be a chief outlet for their talent and experience.

For reference work, a bachelor's degree in both chemistry and in library science is desirable; but, if both degrees are unavailable, one trained in chemistry is preferable to one trained only in library science since there is no chance to learn chemistry on the job and it is possible to learn the routine and the rudiments of library work. For informational abstracting, a master's degree or its equivalent is desirable. Bibliographical work affords work for persons with varying educational backgrounds. Patent searching requires a knowledge of chemistry and often a reading knowledge of French and German. Persons with advance degrees are sought for this type of work because of their broader knowledge of chemistry and wider acquaintance with chemical literature. Chemical editing is a fertile field for development. One must remember, however, that educational qualifications are important, but personal qualifications play a large part in getting and keeping a job. Among the personal qualifications are: persistence to keep searching, imagination to grasp the significance of things, appreciation for order and system, and cooperativeness with fellow workers.

The Staff members of the Institute of Women's Professional Relations inter-

viewed over a hundred women chemists asking each one where the college woman trained in chemistry might best look for interesting and remunerative work. Wherever the interviewer went, she was asked why girls did not prepare themselves for the auxiliary jobs connected with chemistry; as for example, the position of a scientific secretary. Here the field is far from crowded and fairly secure. One element of insecurity does exist, however. The scientific secretary holds a personal job and not an organization position. She goes with her chief.

In *Jobs for the College Graduate in Science,* Edward Menge says there are three ways of earning a livelihood in a profession:

(1) Become a "practitioner" in the profession
(2) Become a teacher
(3) Become a research worker

We have seen that there are limits attached to the "practitioner" when the "practitioner" is a woman; so the other two ways offer women many more opportunities. When a girl is preparing herself for an industrial position or profession in which she competes with men, she is limited (1) by prejudice of her sex, (2) if she is married, by her marital status, and (3) by her capacity to produce. An employer sees in a woman a prospective resignation, therefore her tenure is limited. The woman intent on a real career in chemistry will do well to choose an essential job where she will not have to compete with men. When the consultant from the Hogg Foudation was talking to those high school girls, she asked them how many wished they were men. It was surprising the large showing of hands. Her advice was: "Then do better than men and capitalize on your abilities."

The American Professional Pharmacist carried an article recently, "Women in Pharmacy." This article said:

"Years ago a woman pharmacist was a rarity although there have been women pharmacists since Colonial Days. War-time demands brought a majority of female students into the Colleges of Pharmacy and they should not be lost to Pharmacy."

In like manner we might speak of the girls in our high schools, of the young women in our colleges and universities. There are good minds that can render a service to the chemical profession and should be given an opportunity to use their other abilities along with their science.

We have come a long way in science if we stop to consider that one hundred years ago the first college class containing women had just been graduated and that just sixty-five years have passed since the first technical school allowed women to matriculate. Men may put restrictions and limitations on jobs for women, but man cannot keep the mind of woman from doing its own thinking.

You may recall a cartoon that appeared in our papers last year: *Who'll Bottle Atomic Energy?* Industry is pleading with the giant, "Please come into my bottle!" And industry is a man. War is saying, "Please come into my bottle!" And war is a man. But Science is saying, "Please come into my bottle!" And Science is a woman!

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HIGH-SCHOOL SCIENCE AND MATHEMATICS AS ENTRANCE CREDITS AT SOUTH DAKOTA STATE COLLEGE

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THIS report concerns high-school entrance credits in science and mathematics offered by entrants at South Dakota State College in the fall of 1942. High-school transcripts of regular entrants from four-year accredited high schools in South Dakota were included giving a total of 378 records in the study: two hundred and fifty-five men and one hundred and twenty-three women. Small, medium, and large high schools are referred to because of the variation in offerings in science and mathematics in different size of schools. In this report high schools up to 100 in enrollment are designated as small; those from 100 to 400 enrollment as medium, and large high schools have enrollments over 400. In the group studied, the percentages of students coming from each size group of high school were 27%, 50%, and 23% respectively. It is noteworthy that this group of 378 students came from 141 different South Dakota high schools.

The State Department of Public Instruction of South Dakota requires each accredited high school to require of every graduate at least one high-school unit of science with laboratory work. Customarily high schools offer two or three units of science and quite a number even more. Frequently the local high school adds an additional requirement in science to that required by the State Department. Similarly for mathematics the state requires the accredited high school to require of every graduate at least one unit of mathematics. High schools almost always offer additional mathematics and frequently add an additional mathematics requirement to that set by the state.

For the most part, State College requires of its entrants one high-school unit of science and two high-school units of mathematics. More mathematics is required of entering engineering students. For certain college curricula a student may offer two units of high-school science and one of high-school mathematics. A few students enter with deficiencies in mathematics which they must make up after entrance.

HIGH SCHOOL SCIENCE UNITS AS ENTRANCE CREDIT

This report attempts to answer a few related questions: What science subjects are offered as entrance credit by the men and women? How many units of science credit are offered by men and women? To what extent are the units of science offered as whole and half units? What difference in science units are found for students for small, medium, and large high schools? To what extent do students offer applied science credit in agriculture and home economics?

TABLE I

HIGH-SCHOOL SCIENCE SUBJECTS OFFERED AS ENTRANCE CREDIT BY 378 ENTRANTS AT STATE COLLEGE

Science Subjects	Percentages Men (255)	Women (123)	Both (378)
General Science	88.6	81.3	86.0
Biology	66.2	61.7	64.8
Chemistry	43.9	34.9	41.0
Physics	52.1	31.7	45.0
Physiology	5.5	11.3	7.4
Physiography	1.1	.8	1.0
Botany	.8	....	.5
Zoology	.4	....	.2
Geology	.4	....	.2
Others	.8	....	.5

In referring to Table I, the reader should keep in mind that there are twice as many men as women in the class group. A later statement shows that the men offer more units of science than do the women which

accounts for the percentages for men being higher than for the women with the exception of Physiology. General Science and Biology, as general courses, are the two subjects taken most frequently. Chemistry and Physics as special courses are customarily taken in junior and senior year as electives. The other special courses are taken infrequently. Doubtless considerable content in Physiology is given in the Biology course.

High-school science offered by the group of 378 students was a mean of 2.21 units. The mean for the men was 2.35 units and for the women was 1.91 units. It is evident that the group as a whole are taking considerably more science than is required either by the State Department or by the college for entrance. The men are entering with approximately one-half unit more than do the women.

Tabulation showed that the high-school science credits were largely whole units (full year) rather than half units (half year). Physiology was the exception here and predominately, where it was found, it was half unit of credit.

Here we are reporting the number of units of high-school science offered as entrance credit by students coming from small, medium, and large high schools. The mean numbers found were 2.1, 2.3, and 2.2 units of high-school science for the three size groups respectively. The differences are very small. Undoubtedly the larger high schools are offering more science than is generally elected by the high school students but the students are not utilizing in any large numbers the science that is offered in the larger high schools.

ENTRANCE CREDIT IN APPLIED SCIENCE AS AGRICULTURE AND HOME ECONOMICS

Two questions emerge from the problem of applied science as entrance credit: to what extent do the entering students offer agriculture and home economics units as entrance credit and to what extent is such credit replacing the units of the regular sciences? Here we have a problem of boys with agriculture credit and girls with home-economics credit. Neither the State Department nor the college in its entrance requirements allow students to substitute the agriculture or home-economics credit for the regular science credit required. Scarcely one-quarter (23.1%) of the men offer entrance credit in agriculture whereas nearly two-thirds (63.2%) of the women offer entrance credit in home economics. When offered, the amounts on the average are quite alike for both applied science groups—2.4 units for agriculture and 2.1 units for home economics.

When the entering men are considered as two groups: those entering with agriculture and those entering without it and the science offered by them is considered, the number of units of science are quite close: 2.37 units of science for those with agriculture and 2.42 units of science for those with no agriculture. Definitely the men college entrants who took agriculture in high school have not substituted agriculture for science. Regarding their agriculture credit as applied science and adding that to their regular science they have on the average 4.51 units of high-school science.

The picture for the women with high-school credit in home economics is not quite the same as for the men with agriculture. When the entering women are considered as two groups—those entering with home economics (two-thirds of the women group) and those entering without home economics and the science offered by them is considered, the mean number of units varies somewhat: 1.71 units of science for those with home economics and 2.13 units for those with no home economics. This is a difference of .42 units of science more for those who took science without taking home economics and might reasonably be considered as that much substitution. However, regarding the home economics as applied science and adding

that to their regular science taken they then show a mean of 3.93 units of high-school science.

HIGH-SCHOOL MATHEMATICS UNITS AS ENTRANCE CREDIT

The second part of this report considers high-school mathematics in a somewhat similar way in which the science was considered. Here we are interested as to what mathematics subjects were offered as entrance credit, how many units were offered, to what extent they were whole and half units, and what differences were found for students from small, medium, and large high schools?

TABLE II

HIGH-SCHOOL MATHEMATICS SUBJECTS OFFERED AS ENTRANCE CREDIT BY 378 ENTRANTS AT STATE COLLEGE

	Percentages		
Mathematics Subjects	Men (255)	Women (123)	Both (378)
General mathematics	4.5	.8	9.3
Algebra	95.0	97.0	95.5
Plane geometry	82.0	63.0	73.1
Advanced algebra	30.0	11.0	24.0
Solid geometry	14.0	3.0	10.6
Trigonometry	4.0	....	2.6
Others	.4	....	.3

In referring to Table II the reader should keep in mind that there are twice as many men as women in this class group. A later statement shows that the men offer more units of mathematics than do the women and that partially accounts for most of the percentages for the men being higher than those for the women. In contrast with science where large percentages of the entrants offered entrance credit in general science, relatively few of the group offered general mathematics as entrance credit. Not nearly as many high schools offer general mathematics as offer general science and it is quite probable that students planning to enter college decide they had better stick to the algebra. It is observed in Table II that algebra and plane geometry are generally offered as entrance credit and relatively few enter with the high school credits in advanced mathematics.

High school mathematics offered by this group of 378 students from 141 South Dakota high schools was a mean of 1.75 units. The mean for the men was 1.90 units and for the women was 1.40 units. In the main these amounts are somewhat more than the one unit required of high school students by the State Department of Public Instruction but less than the two units of mathematics quite often required for entrance upon certain curricula at the college. It was pointed out before that for certain curricula at the college a student may offer two units of entrance credit in science and one unit in mathematics instead of the usual amount of one unit of entrance credit in science and two units in mathematics. The men offer about a half unit more of entrance credit in mathematics on the average than do the women. Thirty-six per cent of the men offer more than two units of entrance credit in mathematics whereas 7.3 per cent of the women offer more than two units of mathematics entrance credit.

In our tabulation we found that in practically all cases the credits in general mathematics, algebra, and geometry were in whole units whereas in the special subjects as advanced algebra, solid geometry, and trigonometry the credits were very largely as half units.

There remains to report the units of mathematics offered by students coming from different sizes of high schools as small, medium, and large as classified in this study. These were found to be 1.63, 1.68, and 2.06 units respectively. The students from the larger high schools have about .4 units of mathematics advantage over the other size groups. The larger high schools have a distinct advantage in larger offerings in mathematics.

TABLE III

MEAN SCIENCE AND MATHEMATICS ENTRANCE OFFERED BY MEN AND BY WOMEN FROM SMALL, MEDIUM, AND LARGE HIGH SCHOOLS

Mean Units	Science	Mathematics	Agriculture	Home Economics
Of men	2.35	1.90		
Of women	1.90	1.46		
From small high school	2.10	1.61		
From medium high school	2.30	1.70		
From large high school	2.20	2.10		
By men			2.40	
By women				2.10

SUMMARY

1. In science, nine-tenths of these students offered general science as entrance credit, about two-thirds offered biology, and somewhat fewer than half offered chemistry and physics.

2. Physics is offered somewhat more frequently by the men than by the women.

3. For the most part, science entrance credit is in whole units rather than in half units.

4. The mean units of science offered by students from different size of high schools is practically the same.

5. Scarcely one-fourth of the men presented agriculture as entrance credit while about two-thirds of the women presented entrance home-economics credit.

6. It was evident that the men as high-school students had not used agriculture as a substitute for science in any degree whereas it seemed that the women as high-school students had used home economics as a substitute for science to a small degree.

7. Very little general mathematics was presented as entrance credit by these men and women. Algebra was found almost universally.

8. Geometry was offered as entrance credit by about 82 per cent of the men and by 63 per cent of the women.

9. The men presented about one-half unit more of mathematics entrance credit than did the women.

10. Algebra and geometry were practically always in whole units but advanced mathematics was nearly always in half units.

11. Students from large high schools presented .4 units of mathematics more than those from medium and small high schools.

A PSYCHOLOGICAL APPROACH TO PHYSICS

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THIS is a description of an approach to high school physics, the purpose predominant in the mind of the teacher being that the resultant organization fulfill the requirements commonly characterized as "psychological."[1] There was set up in advance no topical or unit organization of the course, nor planned syllabus organized about those divisions of physics characteristic of high school text books, except that the North Central Association's definition of a course in physics of one Carnegie Unit value was used as indicated later. The order of introduction and scope of phases of subject matter were made dependent upon the emergent interests of pupils, the

[1] Bode, B. H., *Modern Educational Theories*, Macmillan, New York, 1927, pp. 46–54; Billet, R. O., *Fundamentals of Secondary School Teaching*, Houghton Mifflin Company, Boston, 1940, pp. 162–167.

resultant revelation of new attractions, and the revealed necessity of background knowledge for profitable attack on problems, this latter term not being used technically.

There was, however, much planning of, and provision made for materials and equipment. This included an indexed file of a library of over one hundred books, pamphlets and magazine articles dealing with popular science plus the usual array of physics text books and reference materials. The indexed file was arranged by topics, each book having been so analyzed as it was added to the library housed in the classroom, making possible the location of information on almost any topic in one or more books. A collection of lantern slides, an opaque and moving picture projector, and a large number of 36″ by 48″ charts and diagrams prepared over a period of time by the instructor were available. No single laboratory manual or text book was placed in the hands of pupils nor used by them until more than half the term had elapsed.

The time allotment was six forty-five minute periods per week for 38 weeks, two of the periods following consecutively thus providing four forty-five minute periods and one ninety-minute period. The instructor carried a normal teaching load which included classes in mathematics and general science. The classes in physics, an elective subject, comprised high school seniors only.

ORIENTATION PERIOD

The first three weeks were set aside as a time during which pupils were to find answers to such questions as "What is this course about?", "What is the use of it anyhow?", "What do we do and learn here?" The aim was to set up an environment and provide a set of experiences from which would emerge points of contact between pupils' enriched "apperceptive stock" and their interests so that the need for further learning might be demonstrated and made desirable. It was planned to provide these experiences by having pupils read the popular science materials, witness and have minimum learnings and interest checked on talks by the instructor accompanied by demonstrations, observe motion pictures, experience pretests and surveys of background experience, and make contacts with applications of scientific principles by a few visits.

The reading by pupils was used constantly during the orientation period. Books, pamphlets and copies of magazines were displayed upon tables in classroom and laboratory. A diminishing amount of time was provided each period for pupils to select freely those materials that caught their interest. The requirements were that pupils do the reading outside class time, write no more than three hundred words telling what interested them most, something they did not know before, something about which they would like to know more. Books were charged to pupils by signing a card, pupil librarians caring for returned books. The written responses were collected twice weekly for use by the instructor in noting interests, levels of comprehension and response, to serve as cues for guiding pupils into their selected phase of work. The usefulness of this reading is illustrated later.

Variability in reading power was amply illustrated, the instructor being made aware of the necessity of working more closely with certain pupils when they would be dependent upon more technical material for learning in their chosen phase of the subject. Some materials were read to greater extent than others largely as result of favorable pupil comments.

The lecture demonstrations dealt with the following topics:

The Housewife Meets Up with Physics

An account of difficulties with plumbing, gas-stoves, electrical appliances, heating system, and salesmen of household appliances; illustrated with demonstrations.

What Color Is It?

Differently colored fabrics viewed under light from bulbs of different characteristics, reflected light from surfaces of varying color, and in monochromatic light.

Mr. Osgood Gets to Work

Alarm clock, can opener, electric utensils, electric railway, elevator, telephone and typewriter are involved in this one.

Making the Music Louder

One string fiddle on a broom stick, then improved with a cigar box resonator (clamped on), resonating air column and what's wrong with piano music (equally tempered and natural scales illustrated), tuning water tumblers.

What Does It Take to Shock You?; The Human Gas Lighter; The Lightning Struck

Experiments with static electricity.

Buying Cooking Utensils; The Geyser Spouts

Conductivities of different metals and glass model illustrating operation of a geyser.

The Race Is On; The Bridge Collapsed

Illustrating uniform acceleration by gravity of different masses; composition and resolution of forces.

Pupils on a volunteer basis assisted both in the preparation and presentation of the demonstrations accompanying the lectures. This afforded opportunity for the instructor to note the questions pupils asked, the type of contact which prompted the question and the degree of insight or nature of the interest as well as the mechanical aptitude displayed. During the lectures and demonstrations pupils were encouraged to ask questions not all of which the instructor answered, pupils being requested to write many of the questions in their note books for future attention.

The moving pictures, one from each of the major divisions of the subject, were presented on days alternating with the lectures and visits. Pupils were informed that movies in the classroom would involve somewhat different attitudes than those displayed in the theater. The idea was illustrated at the first showing of a film by having pupils recount the details shown. The picture was screened a second time, the instructor requesting that now pupils not only endeavor to note matters overlooked or forgotten, but to note what they wanted to learn more about and what they had not understood very clearly. These records were kept in note books, loose leaves being turned in from time to time so that the instructor might note again the nature and level of the pupils' responses.

The responses of pupils to the showing of the motion pictures might be classified as of two types: (1) those which were concerned with matters of construction or details of manipulation and might be answered by the statement of facts; and (2) those which constituted a good basis for a problem, involving extended study of the subject matter of physics.

At the beginning of the second week of the orientation period the instructor informed the pupils that the goal of all of what had been done and what was still to be presented during the orientation period was the selection by each of several groups of pupils of some phase of the subject, some problem, some project, the learning of something on their own power, the help and guidance of the instructor being assumed. So soon as any group believed they had something upon which they could agree to work they were to consult with the instructor.

On the third day of the orientation period a general science test of 240 items was administered. Items were keyed to reveal responses on different phases of the subject, subscores and total scores indicating specific and general levels of scientific knowledge attained.

Pupils also filled in a questionnaire surveying their vocational or educational goals, their contacts with reading materials of a scientific nature, and experiences to reveal specific interests. Thus on a check list, they were asked to indicate which magazines they had heard of, read occasionally or read frequently. Also they were to indicate experiences with machines, mechanical appliances, toys, and to tell about having taken any appliance apart to

" see how it works." They were also to indicate home or work experiences which might involve contacts with the applications of science as they had learned about such applications from previous reading experiences, hobbies, or the reading done during the orientation period. Throughout the orientation period they were urged to jot down in their note books any pertinent questions suggested by any experiences.

Visits were made to a coal stripping showing hoisting engines and a steam shovel in operation, the school heating system, an ice-making plant and a telephone exchange.

All these responses were tabulated opposite a list of names of pupils so that the instructor would have readily available information on pupil purposes.

EMERGENCE OF PUPIL PURPOSES

By the end of the three week orientation period it was apparent that pupil purposes would be set up by groups rather than by individuals. During the discussion periods for which time was found following scheduled activities of the orientation period, specific pupil interest in some question or problem centered in groups. For example, an advertising pamphlet on brake linings with a graphical representation on the cover depicting distances required to stop an automobile traveling at varying speeds stimulated an argument among three boys on the reasonableness of the conclusions. The instructor immediately capitalized the discussion by asking if they wished to gain the power to judge the reasonableness of the graphical representations. They responded eagerly and were the first group to be launched upon a specific purpose.

The orientation period was extended for seven additional class periods before all members of the class had been drawn into groups with definite purposes. Eight groups finally emerged. Two of the groups became involved in purposes centering in mechanics, three in electricity, one in light, two in heat, and two in what would combine principles of heat and electricity. One boy with highly developed interests in music and who played a first violin in the school orchestra, was interested in constructing what might be called a zylophone constructed of partially filled bottles, but finally allied himself with a group whose specific interest emerged in the realm of electricity.

THE ATTACK ON PURPOSES

The direction of the learning of pupils for the attack on their specific purposes was provided by study guide sheets prepared by the instructor to fit the needs of each group. The preparation of these guide sheets, which often included tailored directions for necessary experiments or controlled observations required an average of two hours daily of the instructor's evenings. The study guide sheets required that pupils keep a running record in note books of the information requisite to the eventual emergence of the desired solution or accomplishment. At the same time they were designed to end at a point where the further progress of the group was stalled, requiring a conference with the instructor. Conferences also were scheduled with each group to last on the average for a quarter of an hour. The conferences afforded an opportunity for determining the genuineness of the learning and the specific needs of individuals. Notes kept by pupils were checked at least once weekly and often more frequently during the group conferences with the instructor, especially when an erroneous idea reared its head. Occasions were frequent when the instructor found it necessary to work for a while with individuals to improve comprehension and teach pupils to use dictionary, index, and table of contents more effectively, as well as insist on careful reading of crucial sentences.

When some of the groups found their progress hindered by lack of knowledge of a tool of further progress, the entire class was set upon the study of that item. This

occurred early with respect to the practical use of the metric system, a half hour's directed measurement in the laboratory sufficing to clear up most of the difficulties.

Laboratory work was done as the necessity for it arose. For example, the group wanting to learn to understand the operation of and to operate the arc stereopticon lantern soon found it necessary to learn how and why a series connection of current supply, arc and rheostat was necessary. This necessitated experimentation on series connections using safe current source and relationships provided by Ohm's law. This group problem spread into heating effect of the electric current, photometry, and lenses. Some of the laboratory work at the outset was demonstration work by the instructor, but only with a single group of pupils, pupils participating in preparing the apparatus assembly and almost invariably repeating the experiments.

Whenever the determination of constants, such as the heat of vaporization of water was found necessary, pupils read widely beforehand to realize that both constants and other effects had to be verified by many determinations by scientists devising and working with apparatus for precision, pupils realizing that their determinations would have large errors for many reasons, and that single observations were very untrustworthy.

As groups completed their pieces of work, they reported on their topic to the entire class, the class being encouraged to ask questions. The presentation was aimed to provide as wide an understanding as possible. The discussion and questions arising during this activity furnished the stimulation for other group purposes, as well as more penetrating insights on the part of those making the presentations.

From time to time the personnel of the groups changed. Opportunities for consultation among groups were frequent. A pupil would often pick up an interest in the projected purposes of a different group and ask permission to shift to that group.

Marking was based upon the quality of the notes kept by pupils, responses during the conferences, excellence of presentation.

The log of the accomplishment of the group purposes and their expansion into further purposes involving the learning and application of a variety of principles, generalizations, and laws is not presented here due to lack of space, but has been compiled for other purposes.

EVALUATION

The work on the group purposes continued for twenty-six weeks, which included the orientation period. At the time this class was conducted, college entrance requirements demanded the submission of laboratory note books to several institutions and three members of the class intended to take the College Entrance Board's Examination in Physics. Since sixty-four per cent of the class had goals involving education beyond high school the instructor felt obliged to discontinue the group purpose procedure at the end of twenty-six weeks so that specific college entrance demands might be met.

On a chart listing topics in physics included in the North Central Association Unit a check was placed opposite each pupil's name and under the appropriate topic as soon as the instructor had evidence that the pupil had acquired a considerable degree of learning of that topic in the pursuit of the group purpose.

At the end of the twenty-six week period "Test V—Physics" of the series of six tests prepared for the Society for the Promotion of Engineering Education by L. L. Thurstone was given the entire class. This test is described as calling "for the application of principles in physics to simple problems." It is unbalanced, however, for the purpose of measuring general achievement in physics, as it contains a preponderance of problems in mechanics including hydraulics and pneumatics of which there are fifteen, one in heat, five in electricity,

three in light and one in sound. The table below compares class achievement with the norms.

Percentile	Class	Norms (6,610 College Freshmen)
25	8	7.3
50	11	10.5
75	12	14.0

Class achievement compares favorably with the norms, except at the 75 percentile level. Had the test been given at the close of the term, achievement at this level might have been improved.

The remaining twelve weeks of the term were spent upon topics in physics which had not been touched upon by any of the groups. For about four weeks the groups remained intact, their learning concerned with topics which other groups had touched upon, so that eventually only topics which no group had met with remained.

Pupils contemplating taking College Entrance Examinations attended special sessions three periods weekly during which reviews were conducted on questions and problems assigned for home study.

Others studying trigonometry were instructed to apply trigonometric procedures in the solution of all problems amenable to that approach.

The contrast between the pupil purposing approach and the teacher directed assignments during the last twelve weeks was apparent in that now more teacher pressure of an extrinsic fashion was necessary, especially upon those pupils who were not motivated by prospects of attending college.

All pupils who took the College Entrance Examination in Physics passed it. Pupils who followed engineering and medical curricula in colleges returned with reports that they found themselves able to adapt to college courses in physics readily and achieve above average grades.

NEW FRONTIERS IN SCIENCE *

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INTRODUCTION

A STUDY of the historical background of the Negro in science in America seems to reveal three definite periods and points the way to a utopian fourth. The first period is typified by the pioneer and the pioneering spirit; the second is one of acquisition of general and special technical education; the third is characterized by an intent to remove barriers of opposition to the Negro's full participation in industry, science and technology [1]; and the fourth period, to which we are zealously looking forward, will be that one which will be characterized by the Negro's full integration into industry, engineering, technology and scientific pursuits generally. It will be one in which the Negro will be chosen on the same basis as any other individual, his scientific ability being the determining factor rather than his color or his previous condition of servitude.

PIONEERING SPIRIT

It has long been an accepted fact that one tenth of America's population has performed only the country's unskilled tasks and that that tenth, our twelve to fourteen million Negroes, have accepted their responsibility and to this end have made their humble contributions toward developing the nation; however, this view is not wholly correct. Scientific literature shows that the Negro has not only given

* An address delivered at Agricultural and Technical College, Greensboro, N. C., May 13, 1946, under the auspices of Beta Kappa Chi Honorary Scientific Society.

freely of his unskilled labors, but has frequently given of his skill in science and technology also. An early example of this fact is found in the life and career of Benjamin Banneker [2], who lived from 1731 to 1802, in Baltimore County, Maryland, and who contributed to the early development of American technological life. Banneker was mathematician, astronomer, surveyor and inventor, which fact caused him to be classed among the great scientists of the eighteenth century. At the age of thirty, he constructed a clock, one of the wonders of his day in that it was the first clock of which every portion was made of American materials and which struck the time of day with perfect precision. Banneker's knowledge of astronomy led him to make mathmatical corrections in Ferguson's, Mayer's, and Leadbetter's books on Astronomy, all of which authors were leading authorities of the period. During the course of his lifetime he published a series of Almanacs which were recognized to be highly accurate. In 1792, in his first Almanac, he predicted an eclipse of the sun, which was later verified by other investigators. Banneker sent a copy of his Almanac to Thomas Jefferson, then Secretary of State, and the latter was so impressed with it that he sent a copy to Monsieur Condorcet, Secretary of the French Academy of Science at Paris. Later, Jefferson, recognizing Banneker's knowledge of the natural sciences recommended him to President George Washington to become one of the members of a committee to make mathematical calculations and survey the grounds upon which the present White House stands.

Not only has the Negro shown skill and made contributions to the early rise of the physical sciences which, as such, have aided greatly in the development of the industrial life of America, but he has also shown skill in medical science and has made lasting contributions to the early rise of American medicine. One of the first accounts of a Negro who was recognized for his aptitude in medicine was that of James Derham [3], born in 1762, at Philadelphia, Pennsylvania, a slave, but who was later taught to read, to write, and the art of mathematical calculation. At a very young age, he was transferred by his master to a certain Doctor Kearnsley, Jr., who taught him how to compound medicines and to assist him with his patients. Following Doctor Kearnsley's death, Derham, after passing through several hands, became the property of a Doctor George West, famous surgeon of the Sixteenth British Regiment, and under whom he performed medical duties during the Revolutionary War. At the close of the war, Doctor West sold Derham to Doctor Dove of New Orleans, Louisiana. Doctor Dove, like his predecessors, found Derham very proficient in medical science. Thus it was Doctor Dove who gave Derham his freedom and secured for him a permit to practice medicine in Louisiana.

Doctor Benjamin Rush, one of the leading medical scientists of his day, and in whose honor Rush Medical College of the University of Chicago is named, heard about the gifted Derham and went to New Orleans to teach him some new techniques in medicine which he thought the latter did not know. After a brief contact with the Negro, Doctor Rush reported the following: "I have conversed with him upon most of the acute and epidemic diseases of the country where he lives and was pleased to find him perfectly acquainted with the modern, simple mode of practice in those diseases. I expected to have suggested some new medicine to him, but he suggested many more to me." [4] Doctor Derham, a contemporary of Benjamin Banneker, like the latter, was highly respected by fellow scientists during the period in which he lived.

Nineteen years after Banneker's death, a portion of the genius which he possessed seemed to have found expression in Solomon G. Brown [5], born February 14, 1829, at Washington, D. C., and who was conversant in biology, geology, chemistry and physics. The death of his father com-

pelled him to seek employment at an early age. In 1884 he came into contact with Lambert Tree, assistant postmaster of Washington, who recognized his scientific ability and recommended him to help Alfred Vail and Professors Joseph Henry and Samuel F. Morse in putting the new magnetic telegraph system into operation. He was thus on hand when the first telegraphic wire was set up between Baltimore and Washington. On more than one occasion, Brown's special interest in physics, principally electricity and magnetism, led him to make public addresses on the subject. The annual reports of the Smithsonian Institute of Washington, D. C., for the years 1878 (page 6) and 1879 (page 7) wherein the name of Solomon G. Brown appears, indicate that he was associated with that organization.

There are other examples of this type, but these will serve to show that the Negro's contribution to the early development of America has been not only unskilled and semi-skilled, but highly skilled workers in science and technology. One may thus agree from the above discussion that Negroes, too, have been pioneers in science in America, and their heritage in the natural sciences dates back to the earliest period in our history. These pioneers met with barriers and personal problems, but, with determination, perseverance and hard work, they have left their indelible imprint upon the sands of science culture in America.

GENERAL AND SPECIAL TECHNICAL EDUCATION

The nineteenth century offered for the Negro in America a new frontier in science. The rise of colleges and universities throughout America gave impetus to this new era and aided greatly in developing the Negro's talents in science and expanding his capacity to do scientific research. In this same regard, the Negro vocational and technical schools of America shared in this responsibility and deserve much credit for the contributions which they have made along the same lines [6].

The new horizon presented new personalities. One of these was Dudley Weldon Woodard, mathematician who wrote a textbook, *Practical Mathematics,* which was used by many schools. Later, while holding a teaching post at Tuskegee Institute, he made a special study, published in *School Science and Mathematics* around 1898 under the title: Tuskegee Geometry. This article pointed out the practical aspects of geometry and the means of making it lively. Dr. Woodard was among the first Negroes in America to receive a Ph.D. degree in mathematics from the University of Pennsylvania. He has done considerable research in topology and has published many articles in the *American Mathematical Bulletin* and other magazines dealing with mathematics.

A Negro student who furnished an example of progress in physics was Lewis Howard Latimer [7], born September 14, 1848, at Chelsea, Massachusetts, and who worked with Thomas A. Edison in the latter's private laboratory for over forty years. Latimer invented many mechanical contrivances, important among which was the carbon filament for the incandescent bulb. Latimer's special interest, like Brown's, lay in physics, especially magnetism and electricity. Thus he came to be considered as an authority on the subject, and, by request, in 1890 wrote a book, *Incandescent Lighting,* for the D. Van Nostrand Company, New York City.

Dr. George Washington Carver [8], best symbol of the struggle, rise and achievement of the Negro scientist in America, appeared on the scene around 1864, and introduced, for the first time in agriculture and chemistry, a new methodology and technique in the handling of common farm products. Carver's many discoveries of the peanut, pecan and soy bean, and his organic dyes made from the clays of Alabama opened up an avenue of

chemistry about which research chemists are just now beginning to learn.

The work of Charles Henry Turner in biology ranks among the best done on animal behavior. Turner was born February 3, 1867, at Cincinnati, Ohio. He received an A.B. and M.A. degree with major work in biology from the University of Cincinnati, and later became professor of biology there. He later left this position to go to the University of Chicago to do work toward a Ph.D. degree in biology which he received in 1893. Later, Dr. Turner collaborated with Dr. C. L. Herrick, famous neurologist of the University of Chicago, in writing a treatise on neurology that is still used in colleges and universities. According to R. W. Sharpe, "although the ostracoda of Europe have now been extensively studied, but little work has been done upon this order in America. Professor C. H. Turner of Clark University, Atlanta, Georgia, has, however, paved the way for American students in this field." [9] Dr. Turner published in official scientific journals sixty studies which were incorporated into standard biological textbooks in America and Europe.

A name, possibly, which has few equals as evidenced by special skill in surgery is that of Dr. Daniel Hale Williams [10], born January 18, 1858, at Hollidaysburg, Pennsylvania. First serving as an apprentice, and in this capacity pursuing several rigorous courses in the basic principles of medicine as given by Dr. Palmer, a physician of Chicago, Dr. Williams then entered Northwestern University Medical College and received the M.D. degree March 28, 1893. Dr. Williams was a serious student of medical science, especially surgery--so much so that shortly after receiving his degree, he was called back to Northwestern University's Medical College and given a position as demonstrator in anatomy which position he held from 1885 to 1888. His most significant contribution was the method devised by him in suturing a stab wound of the heart. As far as is known, his was the first successful attempt to sew wounds of the heart, followed by the uneventful recovery of the patient. Dr. Williams' methods in surgery made their way into textbooks on medicine and surgery and his case on stab wounds and stitches on the heart was quoted by the best authorities of his day. Further, Dr. Williams' work in medicine was translated from English into almost every language of the civilized world.

Thus, one can see that the nineteenth century, with its variety of talented Negro scientists who made substantial contributions, presented new frontiers in science, equaling, if not rivaling, the best produced in America during that period.

REMOVAL OF BARRIERS

The slow, pioneering period characteristic throughout the eighteenth and early nineteenth century and the educative process at work during the nineteenth century served to produce in the twentieth century many experts and ingenious Negro scientists. The twentieth century is a period which may be justly characterized by a constant fight to remove barriers and opposition to the Negro's participation in industry, technology and science generally in America. The acceptance of certain talented Negro scientists on the part of science at large has served somewhat as one means of removing barriers of intolerance and discrimination based purely on race. One such scientist is Dr. Percy L. Julian [11], reputed to be one of America's best organic chemists and who holds a doctorate from the University of Berlin, Germany. Dr. Julian is Director of Research for the Glidden Company, Chicago, Illinois. Another is Nathaniel O. Calloway, Ph.D. in Chemistry, Iowa State College, and recently M.D., University of Illinois Medical College, where he now holds a professorship in the Department of Pharmacology. Yet another was the late Dr. Ernest E. Just, one of America's foremost biologists, who wrote two textbooks

on the subject. Samuel Elmer Imes [12], pioneer in atomic physics, was the first Negro in America to receive a Ph.D. degree in physics. His doctorate was earned at the University of Michigan. His contributions did much in removing barriers. Also, the name of Dr. Louis T. Wright [13], M.D., of the Harvard University Medical College, Police Surgeon of the City of New York, Director of Surgery of Harlem Hospital, co-author of a textbook on surgery, stands out in the fight against scientific intolerance. His position as Director of the N.A.A.C.P. gave him a practical opportunity to fight for the Negro's participation and integration into industry, technology and science. Due to a persistent and concerted effort on the part of well-trained Negro scientists, combined with the aid of liberal-minded white scientists, some progress has been made in breaking down barriers.

PARTICIPATION AND INTEGRATION

History has taught us that in acute crises and emergencies people tend to forget their prejudices and differences. What is true with people as individuals is true with nations. During World War I and World War II, America, along with other nations, forgot her prejudices. The Army and Navy trained thousands of Negroes in special skills, techniques, and sciences. The Negro scientist on the home front was given the opportunity to participate in industry, engineering, technology and science generally in America. In this connection, the Negro scientist made outstanding contributions to the war effort; also he received positions, many of which he has retained in the post-war period. Dr. Floyd R. Banks, physicist, is still Associate Research Professor of the Radiation Department of the Massachusetts Institute of Technology; Dr. J. Ernest Wilkins, outstanding mathematician, is still holding his post as Assistant Professor in the Depart- of Metallurgy of the University of Chicago. It will also be remembered that there were Negro scientists who worked on the atomic bomb: one group worked at Columbia University and another group worked at the University of Chicago. Some of these investigators have been retained by these institutions.

In proportion as America puts into action the true democratic spirit, in proportion as America's Negro youth become aware of their rich heritage of three centuries of contributions and in proportion as they equip and train themselves to perform in the science arena, so will the Negro become absorbed as part and parcel of the new science frontier, regardless to his race, color or previous position of servitude. So then will be realized the fourth period—that of full integration into all fields of scientific endeavor.

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A SCHOOL CONSERVATION PROJECT

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The property originally purchased by the Cuyahoga Heights Board of Education consisted of a rather narrow, quite level strip of land, on which was constructed the building and elementary play ground, and a rough area containing two very large gullies. The athletic grounds were formed by cutting off enough dirt from the top of one hill and side of another to fill one of the large gullies. The athletic field is about 25 feet below the basement level of the school. The filling of this large gully left a bare, clayey slope about 75 yards long at the top and approximately 50 yards from top to bottom. A similar situation, though much smaller, was created at the head of the other gully where the ground was leveled to make a turning area for the school busses and a driveway down to the athletic field. No steps were taken to control the erosion of these bare slopes.

By the end of the third year, the author's first year at Cuyahoga Heights, erosion was quite far along and was beginning to cut back into the level field. This problem was discussed with the superintendent as a conservation project in connection with the author's classes. The author planned the program and the needed materials were purchased by the Board of Education.

In the spring of 1942 this problem was introduced in the biology and nature study classes as a part of a unit on conservation. The greenhouse class studied some of the problems of different soils and plants that would grow on the different soils.

The general topics discussed at varying levels in all the classes were:

1. Erosion and causes of erosion.
2. Causes of rapid run off and how it may be controlled.
3. Types of soils and plants that will grow well on the different soils.
4. Various trees, shrubs, and herbaceous plants that are used for erosion control and the reasons for their use.
5. The selection of the trees to transplant, proper spacing, and how to give them a good start.
6. Organization to get the most done in the time available.

The trees selected were one-year-old Black Locust seedlings. Black Locusts grow rapidly and do well under most conditions. To give the trees a good start in the acid clay soil a fair sized hole was dug for each tree, a small trowel of lime was placed in the bottom of the hole and covered with a shovel of top soil, the tree was set in, and the original clay soil was used to fill the hole. The dirt was packed and an oval shaped depression was left around each tree to catch extra moisture. These trees were spaced approximately 8 feet apart in horizontal rows which were also 8 feet apart. However, the rows were staggered giving the appearance of vertical rows 4 feet apart. This was to break up the space between the vertical rows to more quickly produce some run off control.

In the larger classes two of the more reliable pupils were given the responsibility of laying out the rows. These pupils used a pole, marked at 8 feet, to determine the place for the tree and then drove a stake at the proper place. Another group dug the holes, another put in the lime, another brought the top soil, another distributed the trees, and another group planted the trees. All the groups except the pupils marking the places for transplanting were allowed to change jobs. In this way considerable work was accomplished in one or two periods.

Later a few tons of straw were scattered along a rather narrow strip at the top of the slope and in the largest eroded ditches, and then inoculated lespedizia seed was sown broadcast. The straw was to check run off near the top and to help grass and lespedizia to get started and spread down

the hill. However, the lespedizia stand was poor, but at the present time grass and weeds have spread so that most of the hill is covered with a dense growth of vegetation.

The top soil was piled in three piles at the top of the hill which saved much walking as it had to be carried down the hill to the needed places. The bales of straw were also distributed along the top of the hill which saved a great deal of work.

At that time, the biology classes were scheduled to meet for two consecutive forty-five minute periods two days each week. The greenhouse class was scheduled for double periods five days a week. On the days the biology classes had double periods all pupils in the biology and seventh nature study classes came to school wearing their old shoes and older school clothes. These pupils reported directly to the greenhouse for instructions and then as a group to the project. This saved considerable time and confusion.

This work was done as a project by the greenhouse, biology, and seventh grade nature study classes during their class periods in one or two periods a week. During this period of about four to six weeks in the spring of 1942 these classes transplanted about eight hundred trees. A few trees died, due chiefly to rabbit injury.

Very little work was accomplished the following spring because of frequent rains and muddy conditions. Since that time no more work has been done on this project because the author's time has been devoted to the physical sciences and coaching.

At the present time, spring of 1946, after four seasons of growth, the trees are about twelve feet tall, and are beginning to crowd. A dense growth of grass and weeds has covered the hillside except in a few places. A major part of the erosion has been stopped and the top part of the hill has stopped slipping.

This project was started as a means to study causes of and methods to control erosion. However, this and other waste land owned by the Board of Education could be slowly converted into a school forest by a similar method to provide a variety of trees, shrubs, and flowers to be used as a natural source of materials for nature study.

REFRIGERATION AS A LINK BETWEEN THE PRODUCER AND THE CONSUMER

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THE early development of the principles of refrigeration may be found in the systems used by the ancients for cooling beverages. In a similar manner people used natural ice in the northern countries to keep meat and fish fresh for many months. However, this was not the most satisfactory method for protecting foods, since it placed the storing of man's supply of ice at the whims of nature.

As a result of this handicap, many experiments were conducted in the artificial making of ice. The first American patent for making ice was secured by Jacob Perkins in 1834, on an ice machine using ether as a refrigerant. Another American, Dr. John Gorrie of Florida, invented an ice-making machine in 1850. The first ice-making machine using the principle of ammonia absorption was developed by Ferdinand P. Carre of Paris. In 1863 one of these machines was smuggled through the Civil War blockades and set up at Gretna, Louisiana.

On the basis of these various discoveries, D. W. Davis of Detroit patented a process

in 1868 for freezing fish into solid cakes of ice for shipment to market. By 1890, 2,000 tons of fish had been processed. Various experiments had been carried on to develop means of preserving food in local markets and local areas. But as the knowledge of the principles of refrigeration increased, it was felt that these same processes might be applied to the transportation of foods from one region, one country, and even from one hemisphere to another. It was important to have goods and foods flow from regions of abundance to areas where there was a shortage and greater demand for such products.

In keeping with these new theories, the first refrigerator cars were patented in 1866 and from that time on, car icing of perishables has become one of the major developments influencing directly the very existence of American civilization. Daily tons and tons of food arrive at the local markets just as fresh as they were when placed aboard, in some instances thousands of miles away. The dry ice type of car has transported more than 50,000,000 pounds of perishable commodities, more than 50 per cent of which were quick frozen products. The temperatures of these cars ranges from 12 to 17 degrees Fahrenheit. In addition, the old type refrigerator car has been replaced by self-refrigerating units that allow the shipper or producer to name the average degree of temperature he desires maintained throughout the trip. They have been known to vary only a few degrees from the established temperature.

It is interesting to see how overhead refrigeration eliminates the differences in temperatures found in the old cars with ice bunkers located at both ends. In the new type refrigeration, cars are ready for loading a few moments after the thermostatic control is set. At intervals of 36 to 48 hours as they pass through service stations, the cars are examined by inspectors. These reports are sent to headquarters and have as their chief advantage the elimination of delays for icing. Cars have been delayed for unloading and icing for periods as long as ten days.

Refrigerator cars serve the same purpose as refrigeration in the home. They keep fruits, vegetables, dairy products, meats, fish, and other foods cold so that they will not spoil on the way to market. Refrigerator cars make it possible to ship these products long distances without spoilage. These cars also make it possible for farmers in any part of the country to market their produce in distant places. It is through refrigeration that the consumer enjoys more and better foods. It makes possible not only the interchange of goods in continental America, but world-wide markets are thrown open. For example, the banana, and other perishable fruits and flowers of tropical and sub-tropical countries may be interchanged for the manufactured products of the northern hemispheres. All of these improvements have been made possible through refrigeration. Before this mode of transportation, fresh meats could not be shipped long distances without spoiling. Under modern methods of refrigeration, fresh meats are carried from places of production to areas where a market exists, regardless of distances.

The first shipment of dressed beef by refrigeration was made from the Chicago Stock Yards to the East in 1857 in an ordinary box car fitted with bins of ice. Fresh meats are now chilled or frozen in meat packing plants and wrapped before being loaded into cars. Refrigerator cars for meats are similar to those used in carrying fresh fruits and vegetables except that they are equipped with steel bars. On the other hand, quite often ham, bacon, sausage, butter, eggs, dressed poultry and other food products are loaded and shipped in the same car with fresh fruits and vegetables.

However, the first rail shipment of fruits by refrigeration was made from Southern Illinois to Chicago in 1866. This shipment of fresh strawberries reached the Chicago markets in excellent condition.

After this initial shipment, fruits were shipped from different sections by refrigeration. In May, 1885, strawberries were shipped from Norfolk, Virginia, to New York, and oranges from Florida in 1888. In June, 1889, the first carload of deciduous fruit from California was shipped to New York. " Ice boxes " on wheels have given America fruits and vegetables, poultry, eggs, dairy products, and packing house products within reach of every American home at all seasons of the year. The great demand for all kinds of food, especially the protective foods like citrus fruits, which are highly desirable from a health standpoint, makes it desirable to adopt the most efficient means of transporting them. On the other hand, the supply to people who live long distances from centers of production would be curtailed due to the fact that high transportation costs and inefficient methods would make it unprofitable for producers to continue to ship to those markets.

California orange shippers have been able to reduce the amount of ice they use, especially in the newer types of refrigerator cars, by placing the ice in only the upper half of the bunkers. This is referred to as stage icing, which not only reduces the ice bill, but saves needless freight costs. These savings vary in amount with the type of refrigeration in use. However, the choice of refrigeration depends on the weather or the season of the year, the distance to the market, the kind of refrigerator car available, the condition of the fruit, and the buyer's specification.

The refrigeration of citrus fruits in transit from California became organized as a protective service through the attempts of fruit growers and operators of privately owned refrigerator cars to deliver the fruit in sound condition to markets in the Middle West and the East. The first refrigerator car in California made possible a change in the method of transporting citrus fruits from the relatively costly-expedited freight and ventilated-express service to shipment under refrigeration on slower freight schedule. Refrigeration of oranges in transit is obtained only from ice that is melted. Since the meltage was found to occur chiefly in the upper half of bunkers, the actual surplus ice hauled between regular icing stations under standard refrigeration service is represented by the amount remaining in the bunkers when cars are re-iced.

In addition, the most advanced method of crating lettuce heads and other leafy vegetables for shipment is to bed them down in cracked ice. The melting ice produces the proper combination of cold and moisture obtainable in no other way. From the packing sheds the crates of lettuce go into refrigerator cars or trucks. Two methods of car refrigeration are in use, " bunker icing " and " body icing." In the newer or " body icing " method, fine cracked ice is blown between, over, and around the crates as they are stacked in the car until they are completely embedded. By either method, the use of ice makes it possible for cities hundreds or even thousands of miles away from the farms to enjoy crisp, fresh, vitamin-rich food.

It should be taken into consideration that fruit and vegetable producing areas in the far western states are peculiarly dependent upon efficient and economical means of transportation to get their crops to the consumer in attractive and marketable condition. In 1935 California was shipping annually 70,000 carloads of oranges, 15,000 carloads of lemons, 2,500 carloads of asparagus, 29,000 carloads of cantaloupes and other melons, 6,000 carloads of carrots, 6,000 cauliflower, 8,000 celery, 50,000 grapes, 35,000 lettuce, 10,000 peaches, 10,000 pears and 3,000 carloads of tomatoes, and large quantities of other fruit found in the markets throughout the country. The Yakima and Wenatchee districts of Washington produce 50 per cent of the commercial apples of the United

States as well as pears, onions, berries, cherries, potatoes, and other fruits and vegetables.

Another very effective type of express service designed to provide low temperature refrigeration in transit is the Church container. It was designed by Major Elihu Church for quick frozen foods and for perishables needing low temperatures for their protection. The container can maintain a temperature of 40° below Fahrenheit for 48 hours or more. Either water ice or dry ice may be used. It is about the size of a large trunk mounted on six roller casters, which makes it a very convenient unit that can be handled by one person. It can be loaded at the shipper's warehouse and trundled into the express car with little or no trouble. The minimum weight is 350 pounds, with a service charge of $3.00 for each trip of 48 hours or less. The charge for more than 48 hours and less than 72 is $3.50, and for detention longer than 72 hours, a charge of 50 cents per day. Shippers provide the refrigerant, allowing 24 hours for loading.

Also one of its outstanding values is its utility. The products are sold from the container, which is a very helpful solution to the retailer who lacks adequate storage facilities. The marked industrial and agricultural significance of the new service was widely commented on by newspapers, because of its possibilities in accomplishing a more widespread distribution of quick frozen food products, the processing of which has become an expanding national industry. In addition, it had previously been thought that carload lots of frozen food could not be shipped to communities of less than 10,000 because of spoilage. This new container has almost door-to-door contact and carries frozen food to the village as well as the urban centers. Again, rare delicacies in quick frozen form, only obtainable at distant points, have been made available on a larger scale. These varied processes have enabled the shippers to extend the areas of their consumption.

Refrigeration on ships have had a similar influence to that of trains in the transporting of fruits, vegetables, meats, and dairy products. Butter travels from New Zealand to England and meat from South America and Australia to the United States and England. There were shipments of frozen beef from Australia to England as early as 1874 and 1875. Meat from Argentina has been shipped to New York since 1912. Meat freezing plants are located in Buenos Aires and Santa Fe. It is interesting to note that a Spanish company built these meat freezing plants and maintains cold storage warehouses in Bilbao and other Spanish towns. Company-owned refrigerator ships carry the meat to Europe. In a similar manner, meat freezing plants are found in each of the chief ports of New Zealand. Every day ships loaded with frozen lamb, mutton, and beef leave for European and American ports.

Thus it is seen that refrigeration has had revolutionary effects upon production and trade. Perishable commodities could not be shipped between the lands south of the equator to those north of it until a way was found to protect these products against spoilage due to high temperatures and high humidity in equatorial regions. The most productive regions of the southern hemisphere have little to exchange with each other. In view of this fact, Southeastern South America, Southeastern Australia, and South Africa, all having similar climates, grow similar products and in quantities larger than they can use. Their principal market for surplus products is in the Northern hemisphere.

Just as the car and ship refrigeration have revolutionized trade, plane refrigeration will prove of greater advantage from the point of speed in transporting commodities. The most perishable fruits and vegetables from Central and South America may become American specialties through the use of air cargo facilities. This will also give impetus to a new and profitable

business of importing favorite Latin American foods.

The first plane refrigerator service was begun November 2, 1945. The plane left San Francisco, making stops at Los Angeles, Salt Lake City, and Denver. The United Air Line's plane arrived at LaGuardia Field, New York City, with a cargo of vegetables, flowers, and live lobsters. Here one sees that the advantage of the fastest speed has been added to that of refrigeration.

Another important phase of refrigeration is the warehouse or storage facilities. Refrigeration is a big business employing many people. If all the storage warehouses were joined, they would cover a distance 140 miles long, and if all the 119,000 refrigerator cars were joined together, these would represent 45 miles more, and refrigerated ships would add another 22 miles. In these miles of cold storage space are kept 23,000 tons of butter, 51,000 tons of cheese, and 32,000 tons of eggs. Services furnished by the warehouses delay the deterioration of perishable foods and preserves their original fine quality and wholesomeness.

In addition, refrigerated warehouses act as a stabilizer of food prices. Thus the producer receives a higher price for his products and the consumer pays less. However, if the surplus were not stored at the time of peak production, market gluts would develop, forcing down the prices paid producers. For example, if eggs, butter, apples, and many other perishables were not stored at the point of peak production, a scarcity of these commodities would occur later in the year. It can readily be seen that with the large urban population of most regions, refrigeration warehouses are indispensable in the orderly distribution of goods. Chicago alone has over 20 separate plants with a capacity of over 40 million cubic feet of refrigerated space. As in transportation, one sees that the principal commodities for which storage space is needed are meats, poultry, fish, eggs, butter, lard, cheese, nuts, dried fruit, apples, citrus fruits, and vegetables.

Warehouses do more than store and distribute products. They act as branch houses, receiving the producer's mail and sending out his orders. There are many advantages gained by the producer, and chief among these are:

1. Producers' market always has a flow of goods.
2. Customers always have goods on hand.
3. Large open accounts are avoided because customers receive goods as they need them.
4. The producer has definite and absolute control over his sales.

Producers of seasonal products seldom find it economical to provide all of their own storage, either at their plants or elsewhere. If this were done, the producers would be providing equipment and buildings the year around that are needed only for a short time during the year. Again, there is the danger of destruction of the surplus stock by fire, flood, or storm. These disasters may be avoided if the seasonal commodities are dispersed in public warehouses near marketing centers and thereby making goods available at points closer to their ultimate markets than the plant itself. Similarly, the cost of handling is an important item. Cold storage warehouse services are charged on the basis of units of goods handled. However, when the producer attends to his own storage, his costs vary with the amount of business handled.

In like manner, interregional producers realize that delivery is a very important part of selling, and in view of this fact, some keep "spot stock" near their customers, especially if these customers are retailers. It is also becoming the outstanding mode of distribution used by producers dealing with brokers and wholesalers, because of the buying in small quantities that necessitates quick delivery.

The development of fruit and vegetable products in various areas and the prosperity and welfare of all the people so

engaged, as well as communities supported by these industries, are based entirely upon the successful transportation of the produce to market. Furthermore, the constant and varied supply of fresh fruits and vegetables on the market has changed the dietary habits of the nation. No longer are fruits and vegetables to be had only seasonally. Most of them are available from some producing area every month in the year, always in fresh, attractive condition, and usually at prices within reach of the consumer.

Thus one sees that the Refrigerated Warehousing Industry of America stands between the rural areas where foods are produced and the great metropolitan cities in which they are consumed. It forms a necessary link in the chain of distribution where the surpluses of these necessities of life are held and preserved from seasons of abundant supply to the periods of scarcity. Cold storage preserves the surplus food supply of the nation. In preserving these foods, they also seal in the original fine quality and wholesomeness of fresh foods and eliminate a wastage of these essential products, for only the finest quality is put aside for cold storage. In addition, these foods are inspected again before being placed in the warehouse. Cold storage is indispensable to the orderly marketing of perishables. It fills a great public need. It has been said that the American worker of today is able to secure foods of better quality, of greater variety, and in larger quantities than kings could demand hundreds of years ago.

In addition, refrigeration not only has given people a sense of well-being and pleasure from the standpoint of food, but has influenced the health, mentality, and has also prolonged the life span of the American people. In a similar view, the New York Agricultural Department believes that cold storage has spread the feast over famine months with supplies of all perishable foods. The Department further states that without refrigeration, these products would flood the market at the wrong time and create a great shortage at others. In addition, storage facilities are essential to our economic life because they provide the necessary means for a balanced diet for the whole year, benefiting both the consumer and the producer.

Contrary to some popular beliefs, stored products are not held for long or indefinite periods. These holdings are regulated by state laws and are periodically inspected. One can readily see that sanitation plays a very important part in the regulation of the warehouse as well as the commodities stored there.

In its influence on agriculture, cold storage has caused a greater production of all perishable products by opening up new markets and spreading their consumption over a longer period of time. It not only assures producers of better prices than could otherwise be had, but it also insures the consumer against excessive high food costs during periods of scant food production.

Again, in its influence on urban centers, it has contributed to their growth as well as aiding in the reduction of misery and suffering from floods, strikes, and other disasters causing food shortages. Today, most cities, regardless of distance from market, have the same kind of products at all times. There was a time when the shipping cost of handling tomatoes, strawberries, lettuce, and other perishables was so high that people of low income could not afford them but now they can be bought at any season of the year.

In addition to meat products held in storage, there is an abundance of fruits and vegetables. The United States Department of Agriculture gives statistics on the car lot shipments from stations within the United States for the calendar year 1932–33. Shipments reported for 1932 totaled 843,881 cars and in 1933 decreased to 798,461 cars. The totals for these two years was nearly 26 per cent less than that of the two preceding years. This decrease

in the movement of fruits and vegetables may be attributed to the greater use of motor trucks and the lowered purchasing power of the consumer as a result of the depression. Comparing the figures for car lot movements of fruits and vegetables of 1943 with those of 1933, 125,015 car lots moved in 1943 for distances ranging from a few miles to more than 3,000 miles, necessitating the use of more than 13,000,000 tons of ice.

In a similar manner it is interesting to note the volume of eggs and butter in cold storage for 1935 despite the lack of comparable data for 1945. In 1935 there were 8 million cases, or 240 million dozen, eggs, and 110 million pounds of butter. For these commodities, cold storage buildings reached their peak at different times of the year. For example, better eggs in the spring and the best butter in June, while the best poultry is available in the fall and early winter months.

Another significant and probably the latest attempt of the frozen food firms is the turning out of complete frozen meals. The dinner, breakfast or lunch may be flown or transported by ship or rail from one region to another or one country to another without damage to the food. The New York *Times* for November 11, 1945, listed certain benefits that may be derived from this latest service. Among them are: a practical education in the kind of foods for which our various sections and regions are famous. A second observation involves an economic problem, since the West produced 50 per cent of the frozen food in 1944, but it may now have keen competition in the East because the East is nearer the big markets. Again, there may be lessons in democratic tolerance as well as an appreciation for regional differences which do much to weld the states into "a strong indissoluble union."

Refrigeration has opened up the world to a large and much needed trade. It has also served to bring parts of each continent into closer touch with other parts through better transportation facilities.

EDUCATION OF A YOUNG SCIENTIST

Dr. Leslie Leben

Two years after matriculating, in the summer of 1932, I reached the next stage in the British educational system, Higher School Certificate. This is an advanced school examination of a more specialized kind, and in working for it the student has to make the first preliminary choice between science and the humanities. I chose science, physics, chemistry, mathematics and applied mathematics and, in addition, subsidiary French.

On the results of this examination State scholarships are awarded for three years education at any university. These awards cover all tuition fees and carry a money grant of £80 ($320) per year. State scholars can, of course, hold their scholarships at Oxford and Cambridge, but since these universities have their own entrance and scholarship examinations, students can also sit for these examinations and win further awards. I therefore, sat for the Cambridge examination in December 1932, and won a major scholarship in Natural Sciences worth £100 ($400) a year. This allowed me to choose my college, and I chose Emmanuel.

Now my financial problems were solved, for, those two scholarships—State and Cambridge University—afforded me sufficient to live on and study for the next three years.

Oxford and Cambridge are the most expensive universities in Britain, and though many students come from wealthy families I was surprised to find how many

there are who receive either scholarships or, even more often, grants, from one of the many sources available.

Let me give you a picture of my work for a degree in Natural Sciences. During the first two years the student must specialize in three subjects. I chose physics, chemistry, physiology, with mathematics as a voluntary extra half subject. For six days a week I had four hours work every morning—two lectures of one hour each and two hours laboratory work between lectures. In addition I had two hours of laboratory work three afternoons a week, and three hours individual supervision. This was meant to provide roughly three lectures and three hours laboratory work in each subject per week.

Only science students have laboratory work in the afternoon; most other students spend the afternoons in sport, rowing athletics, cricket, football, riding or swimming, according to season.

There is no lack of activity for leisure—the real problem is to find time for a great variety of interests. Professors and lecturers keep "open house" on one particular day of the week and students are made to feel at home, encouraged to talk freely and to mix informally and happily with distinguished scholars from all the faculties. I think I learned as much from these friendly conversations with different specialists gathered together over coffee or a glass of beer as I did from the more formal instruction of the lecture room and laboratory.

I obtained First Class Honors in my University degree, the B.A. (Bachelor of Arts, the degree awarded at Cambridge for both Arts and Sciences subjects), and was therefore encouraged to stay at Cambridge and work for the Research degree of Doctor of Philosophy. This was made possible by the award of a two-year research grant of £250 ($1,000) a year by the Government Department of Scientific and Industrial Research for a special study of the problems of friction and lubrication. At the end of my second year of research I wrote a long progress report on my work and applied for a research grant from the Goldsmith's Company, one of the City of London Guilds which, like many others, devotes large sums of money to educational purposes.

They gave me a grant of £250 for my third year, and in the middle of it Cambridge University awarded me a further University research scholarship of £150 ($600). At the end of three years research, in the early summer of 1939, I obtained the degree of Ph.D. Meanwhile I had published several scientific papers in collaboration with my supervisor, a common practice among research students at British universities. On receiving my research degree the Department of Scientific and Industrial Research awarded me a further grant of £300 or $1,200 a year for three years to continue work on friction and lubrication.

In the autumn of 1939, when war broke out, I volunteered for research work in the defence industries and was engaged on this until the end of the war. In May, 1946, I was transferred to a unit organized for the post-war development of plastics and sent on a mission to America where I spent four months in travel, observation and study. Since my return to Britain I have been employed in this special branch of industrial research.

I suppose I had the best education that Britain could provide, and certainly ideal opportunities for research. Even my holidays ranged far and wide. In 1935 I went with a student walking party for a holiday in the Danube Valley; in 1937 to Switzerland, in 1938 to the Breton coast. These holidays were organized for students by the National Students' Union and I enjoyed them enormously.

I do not pretend that every student whose parents were unable to support him had opportunities equal to mine. But even ten and more years ago—the time to which I refer—many students enjoyed similar

opportunities. Now the provisions of Britain's new Education Act will extend these opportunities to an infinitely greater number.

My own family record, incidentally, may be of interest. In my generation there are only five of us: my sister, one male cousin, two female cousins, and myself. The two men in this small group both went to Cambridge University on State-plus-Cambridge University scholarships. The same applies to one female cousin. The other didn't want to go to college. My sister went to London University on a scholarship. Three of us chose to go on to research. My cousin was given two research (travelling) scholarships by her Women's College in Cambridge to study the Russian language and life in the U.S.S.R.; my sister was awarded a post-graduate scholarship by London University which enabled her to take a special Diploma in Dietetics and I have already described my own long-term research grants. There are many families in Britain who could show a similar record: There will be even more in the future.

BOOK REVIEWS

Price, William Evans, and Bruce, George H. *Chemistry and Human Affairs.* Yonkers: World Book Company, 1946. 788 p. $2.68.

Chemistry and Human Affairs places emphasis upon both the cultural and utilitarian aspects, following a somewhat middle of the road path between the strictly college preparatory and the applied or consumer type. The authors develop basic principles and their applications, constantly keeping in mind the interests and abilities of the average, non-scientific student.

The work is organized around seventeen units. Each unit has four or five problems, experiments where applicable, and a problem summary guide. Each unit closes with sections called "Applying What You Have Learned" and "Suggestions for Outside Reading." The appendix includes in brief form some of the more important topics found in traditional books but omitted from this text. The last four units are, (1) chemistry in home and garden, (2) chemistry and health, (3) chemistry in industry, and (4) milestones in chemistry.

The authors are chemistry teachers of long high school experience, Mr. Price teaching chemistry in the Clifford J. Scott High School of East Orange, New Jersey. The late Mr. Bruce was for many years a teacher of chemistry at the Horace Mann School for Boys of Teachers College, Columbia University. —G. E. D.

Whitman, Walter G., and Peck, A. P. *Physics.* New York: American Book Company, 1946. 629 p. $3.00.

Here is an interestingly written book that covers the subject adequately, develops principles thoroughly, stresses familiar applications, and is replete (685) with pertinent photographs and illustrations. It is a book that should appeal to the pupil, difficult enough to be challenging to the best, and yet not so mathematical as to discourage the non-college pupil.

We like the emphasis on everyday and modern applications. There is a chapter on weather and another on heating, air conditioning, and refrigeration. Then there are entire units on the motor car, the airplane, photography, and electronics.

Following the text of each chapter are one or more related "sidelights." These sidelights often record some step in the development of the science or point out some unusual application. Their purpose is to excite the interest and pique the curiosity, to instill into the student a greater appreciation of the importance of physics.

At the end of each chapter is a summary of basic principles and facts, review exercises, problems, and a list of questions "for clear thinking."

Altogether this seems to be one of the best secondary physics texts that have been published and should be most teachable in the classroom. The senior author is well known to readers of Science Education as a former editor, and as a contributor to Science Education, and as author of texts in physics and several sciences. For many years he served as Head of the Physical Science Department of the State Teachers College at Salem, Massachusetts. Mr. Peck, also known to many science teachers, is managing editor of the *Scientific American.* —C. M. P.

Devon, Francis. *The Story of the Helicopter.* New York: Coward-McCann, Inc., 1946. 182 p. $3.00.

For more than four decades, men have been trying to design a better flying machine. The airplane fulfills a need but its high forward speed needed to take off, fly, and land led men to think of a machine of greater potential utility. Then the helicopter was born. It could take off straight up and land straight down and fly in weather that often kept conventional aircraft on the ground. *The Story of the Helicopter* is the first book of its kind on helicopting. In narrative and essay form it tells in lay language the

machine's possibilities and the engineering skill that made the helicopter possible. The author is a pilot and for five years was aviation editor of the Associated Press and was the first winner of the Transcontinental and Western Air annual award for "consistently best-informed writing on aviation." There are over thirty illustrations showing the historical events that led up to the invention of the helicopter. The book opens with that bright windless spring day of 1940 when that Russian-born engineer, Igor Sikorsky, brought out that anything but appealing vehicle with a framework that looked like "the ribs of a Texas longhorn after a hard winter on the range" and made it fly. *The Story of the Helicopter* is a good story and also good aeronautical information for the lay reader. —G. O.

HORSLEY, TERENCE. *Soaring Flight.* New York: Current Books, Inc., A. A. Wyn, Publisher, 1946. 326 p. $4.00.

Here is a first up-to-the-minute book on the art of gliding. The author is not only an experienced glider pilot but he has the ability to use his technical knowledge and express it with feeling and beauty so that the reader thoroughly enjoys the majesty of motorless flight. The armchair flyer will find infinite pleasure in reading this book and students of aeronautics and aerodynamics will find a wealth of valuable technical information. There are forty-two pages of amazing, dramatic aviation photographs and an introduction by Roel I. Wolfson, editor of *Flying Age.* A few titles taken at random will reveal the contents of the book: The Aircraft, Soaring Sites, First Lessons, Learning Through Failure, Some More Failures, Advanced Soaring, Cross-country Soaring, Cloud Sense, Blind Flying and Forced Landings. —G. O.

BROWN, HARRISON. *Must Destruction Be Our Destiny?* New York: Simon and Schuster, 1946. 158 p. $2.00.

In this book a scientist speaks as a citizen. Dr. Brown writes with authority. He has a Ph.D. in chemistry from Johns Hopkins University, was assistant director of chemistry at the Clinton Laboratories in Oak Ridge, and at present is engaged in atomic energy research at the Institute for Nuclear Studies at the University of Chicago. The well-known Clifton Fadiman describes *Must Destruction Be Our Destiny* as the most important book ever published by the publishers—the clearest, calmest, most logical exposition of what the atomic bomb has done and will do. And one may add that the results at Bikini have in no way lessened the destructive consequences and possibilities of the atomic bomb. No book has been published that quite equals this one in its penetrating and keen analysis of the problems facing this atomic age.

Possible courses of action for the handling of the bomb are based on four fundamental premises:

First: There exists a weapon which is capable of destroying a city to such an extent that the continued functioning of that city as an organized center of living would be impossible.

Second: This weapon is small. It can probably be concealed in a building or it can be carried by a single plane or rocket.

Third: Great Britain and Canada share with the United States the bulk of technical information that is necessary for the production of this weapon.

Fourth: To the best of our knowledge the United States is the only nation that possesses either the actual weapon or all of the final, purified ingredients from which the weapon can be constructed.

Certain conclusions that are agreed upon by scientists: (1) we can expect no enduring monopoly, (2) we can expect no specific defense, (3) the fallacy of supremacy. No nation can find security in the preparation of stock of atomic bombs. (4) The use and manufacture of atomic bombs must be controlled by a world authority if the peoples of this earth are to avoid their own destruction.

The author describes the various types of possible control, with world authority, as the only feasible, practical method of control. Later chapters discuss some of the possible peace time uses of atomic energy, statements from many other scientists, and a brief description of the scientific theory underlying the release of atomic energy.

The author draws the following conclusions concerning the various aspects of control:

1. If the relationship between nations continues as in the past, we can expect other nations to possess some atomic bombs within three years, and saturation quantities of them within seven years.

2. We can expect no specific defense against the atomic bomb.

3. Under the circumstances, a sudden attack on our country resulting in the death of at least fifteen million persons is a possibility bordering upon the probability.

4. Such an attack could be made by another nation at a cost to her of not much more than two billion dollars.

5. In order to decrease the effectiveness of such an attack and to increase the length of time remaining before other nations possess saturation quantities of bombs, it will be necessary for us to disperse our cities and industries, and to set up auxiliary defenses, at a cost to us of something like 250 billion dollars.

6. In order to carry out such measures, and at the same time put ourselves in a position to strike first rather than last, we must grant sweeping powers in our government. The granting of such powers would, in effect, make us a totalitarian nation.

7. When other nations possess bombs in saturation quantities, we can expect no security in the possession of more and larger bombs.

8. Therefore, adequate world control of the atomic bomb is necessary.

9. In all probability, if another major war occurs, atomic bombs will be used.

10. Because of the close connection between the atomic bomb and war, war itself must be controlled if the atomic bomb is to be controlled.

11. Under no circumstances can we trust in a treaty or covenant system to prevent either the manufacture of atomic bombs or the onset of another war.

12. We cannot expect the additional horrors of war brought about by the atomic bomb to prevent either another war or the use of atomic bombs in such a war.

13. We cannot expect permanent security against atomic bombs by any other means other than a rule of law-world government.

14. The United Nations as set up at the present time is incapable of satisfactorily controlling the atomic bomb. Fundamental changes must be made before we can consider this organization equal to the task.

15. Minimum requirements for the control of the atomic bomb under the United Nations Organization call for elimination of the veto power of big nations—at least over action taken under atomic bomb rulings—and for the adoption of a ruling prohibiting secession from the organization.

16. The technology of bomb production is such that a control system must be based upon one of two alternatives: (1) foregoing many peacetime advantages of atomic power in return for relatively easy control; or (b) retaining all peacetime advantages of atomic power at the cost of difficult control.

17. We can lessen, to a great extent, the technological difficulties of control if we encourage the fundamental concept that scientists are citizens of the world and that their first responsibility is to humanity as a whole rather than to any one nation. —C. M. P.

POTTER, ROBERT D. *The Atomic Revolution.* New York: Robert M. McBride and Company, 1946. 165 p. $3.50.

We almost need a new term rather than *revolution* to convey the implications of the atomic bomb. Certainly the atomic bomb is that but it is even more. No other discovery or invention of man has had the potentialities for his doom as has the development of the atomic bomb. And in this Year 2 of the Atomic Era serious consideration must be given to the greatest problem the whole human race has ever had to face. Much was written, many suggestions were made in Year 1, but actually little was done specifically, concretely to realistically face the problems thrust at us by the atomic bomb. A part of the fault—negligence—lies within the American people, but not all. The rest of the world must be convinced that it is their problem and not a peculiar, isolated American problem.

This is an excellent treatise supplemented by many excellent photographs. Part I presents the story of the atomic energy from the day of its liberation from the uranium atom in January, 1939, to August, 1945. Here are discussed the ramifications and implications of the discovery of atomic energy in the realms of technology, medicine, meteorology, sociology, and politics. Part II describes the more technical aspects of atomic energy—the atom, atom smashing, and the production of atomic energy. The latter part makes it an excellent reference for the science teacher and science class. But it is an unusually well written account for any layman, with larger than normal type on an extra fine quality of paper. This has made for some unusually fine photographs. Altogether Mr. Potter has written one of the best books, if not the best, on the atomic bomb that a layman can find. —R. J. A.

GAMOW, GEORGE. *Atomic Energy in Cosmic and Human Life.* New York: The Macmillan Company, 1946. 161 p. $3.00.

Beginning with the discovery of radioactivity 50 years ago, the author tells of the various experiments and discoveries that have brought us now to the splitting of the atom. He shows that energy must be applied from outside to start the fission of atoms, but when once started, an enormous amount of stored energy is let loose. "How can man use the atomic energy?" is discussed at length in a simple and interesting manner. Much information relating to the production of the atomic bomb is given, also some suggestions about the possible peace-time uses of this concentrated energy. The book ends with a table of 94 elements, giving their atomic numbers and the masses of their isotopes. —W. G. W.

WEIDENREICH, FRANZ. *Apes, Giants, and Man.* Chicago: The University of Chicago Press, 1946. 122 p. $2.50.

The author of this book is known internationally as one of the world's most scholarly scientists interested in the biological history of man. He was dismissed from the University of Strassburg in 1918, and from the Universities of Heidelberg and Frankfort in 1935. The Nazis claimed that Dr. Weidenreich was of non-German national status. It is also likely that the reported evidences against the asserted pure Aryan nature of the German people had much to do with the dismissal. However, when a "master race's" wishes and proved scientific data collide, the race must be humiliated as the inevitable result of its own actions. And this particular scientific worker, with his head richly stored with the accumulations of decades of organized knowledge, found congenial working conditions in the un-

matched facilities of the American Museum of Natural History. The lectures which compose the book were delivered at the University of California in 1945, and are now published by an outstanding press which insures adequate presentation to the intelligent reading public.

While the author accepts the general claim of an ape-like ancestry of man, he develops many variants from common interpretations. The relationship may be real, but certainly is not close in some of its features. Thus, apes like man have two hands and two feet. But apes travel on all four and may use any one of the four to serve as hands. Man is upright, apes are not, and man's "hind feet" are organs of support and locomotion. Man's entire skeleton, though its parts correspond to parts of the ape skeleton, is so very different, that added connecting links are needed. More time than usually allowed must be assigned in order that slow processes of evolution could have brought man out of the foggy and almost interminable ages upon ages during which man's anatomy and nervous system could allow him to rise above the huge and violent but less alert masters of the earth.

Weidenreich's third of his five chapters seems to contain his major contributions to man's relatively recent, but actually very ancient history. First he discards the claim that existing pigmy peoples represent the closest human ancestral life. Dwarf humans have less structural resemblance to fossil specimens than to other humans. The fossil remains of Pithecanthropus indicate large, not small ancestors. The same is true of fossils of Sinanthropus. In 1939, working in Peking with von Koenigswald, the two studied a new specimen from Java, and later secured added fossil material from the same source. These specimens were named Pithecanthropus robustus by Weidenreich, and Meganthropus paleojavanicus by Von Kienigswald. The latter worker also assigned one fossil the name Gigantopithecus. Whatever the names applied, the author points out that these new fossils and many previously known are of giant ancestral human forms. The fossils from oldest rocks and gravels indicate greater giantism than those of later strata. The discovery of the Java man in 1891, the many discoveries since that date, give great promise for other discoveries from which may be settled many perplexing problems regarding man's biological ancestry. —O. W. C.

YATES, RAYMOND F. *The Working Electron.* New York: Harper and Brothers, 1946. 247 p. $2.50.

This complex science subject is made easy to understand by its clear and simple treatment. The author touches upon the historical development of electronic devices and gives exceptionally simple explanations of how electrons are produced and controlled. We find here explanations of what goes on in radio tubes, how the electric eye operates relays for opening doors, detecting burglars and many other useful devices. Here, also, are the elements of radar, high frequency heating, supersonics, and the operation of the cyclotron in smashing atoms. It explains most of the marvelous work which the electron is performing in our presentday world. —W. G. W.

BUSH, VANNEVAR. *Endless Horizons.* Washingington: Public Affairs Press, 1946. 182 p. $2.50.

Unlike the man who a century ago gave up his job in the Patent Office because he believed there could be no more mechanical devices invented that were worthwhile, Dr. Bush, today, sees no limit to the possibilities of invention. As we travel forward in science achievement we never reach the horizon, because it constantly moves on ahead of us.

This intensely interesting book compares the living of our forefathers with conditions surrounding us today and gives us a glimpse of the future. It treats such topics as "The War Against Disease," "Renewal of Science Talent," "Control of Atomic Energy," "Qualities of a Profession," "Need for Patent Reform" and "Science for World Service." Throughout the book Dr. Bush is constantly emphasizing the importance of science education and stresses the need of developing more scientically trained men. —W. G. W.

CARLISLE, NORMAN. *The Modern Wonder Book of Trains and Railroading.* Philadelphia: The John C. Winston Company, 1946. 289 p. $2.50.

Railroading has come a long way from tiny steam engines to giant Diesels. In 1769 Captain Nicholas Cugnot startled Paris with his moving steam engine. It traveled at the great pace of three miles an hour. Although its first run was a success, it overturned on the second one, and the French Government decided that it was altogether too dangerous a contrivance. John Stevens, one of the great men of early railroading, designed the locomotive in 1825. Robert L. Stevens, son of the great railroad pioneer, on a trip across the Atlantic in 1831, whittled out a wooden model for the T-shaped iron rail, which he felt would carry a very heavy weight. This rail was very similar to the ones in use today. To hold it down he also developed the hookhead railroad spike.

This is truly a wonder book of railroading and it is full of thrilling stories, stories of danger, heroism and accomplishment. The conversion of iron into steel by the Bessemer process made it possible to make steel rails, for steel rails can carry loads three times as heavy per axle as can iron, while the wearing and safety factors are far superior to iron. Most steel rail is now made by the open-hearth process. The continuous rail is described and it is stated that it may well be the rail of tomorrow. An act of heroism on the part of an engineer is described.

Seeing a small child on the track, he rushed down on the front of the train and just in time snatched it up and saved its life. Bergendahl invented the snow plow, but he was cheated out of any financial reward for what he had done. McCartney and the near-perfect stone bridge; the great engineering feats in the construction of tunnels, and the dangers of logging make interesting reading. Names which are of significance in the story of railroading are "Crazy" Judah, Leland Stanford, Charles Crocker, McMurtie, Death Valley Scotty, Andrews and Wilkins, and many others.

The book includes a glossary of the terms and words that railroad men use, for they have a language all their own. Also, it is illustrated profusely with photographs. The general reader will read the book with intense interest and pleasure. Boys will especially enjoy the book. It is of great value in the study of transportation, economics, geography and science.

—F. M. D.

AMISS, JOHN M., AND SHERMAN, ESTHER. *New Careers in Industry*. New York: McGraw-Hill Book Company, Inc., 1946. 227 p. $2.50.

Men who are builders and artisans—the job setter, machinist, toolmaker, diemaker, patternmaker, and machine rebuilding and repair workmen, all need similar qualifications. The general qualifications are at least twelfth grade education or equivalent with emphasis on mathematics and science. They need good health, eyesight, stamina, patience and tolerance. They need to be willing to be tedious and painstaking in their work. They should like to work with tools and machines; be able to take machines apart and put them back together again.

The authors do not hesitate to show that much of the preparation, work, and struggle for advancement is not easy. And they say if you wish to be a machinist, "then prepare to use your head and your hands and your heart. For you must study from books and from teachers and work many problems; you must bend your back to a heavy task and feel with the tips of your fingers the life in both metal and machines. And you must have the heart to work in grease and grime and oil and dirt and noise and confusion, to work at monotonous, repetitive, never-ending drudgery, then to rise almost to the height of creative genius and "lick a tough job". And when you've once done that, and perhaps a real old-timer spits out his tobacco juice looks at you appraisingly and says, 'might make a shopman out of you, after all,' then you'll be on your way, and no one will be fool enough to tell you what it is to be a machinist—you'll know."

The real toolmaker is finicky; he must be finicky; for he is a careful accurate, precise worker. He makes from detailed blueprints such essential equipment as jigs, fixtures, cutting tools and gauges. Above all he must be a perfectionist and to be that he must have the patience of Job.

Duties, working conditions, wages, qualifications, aptitude, physical conditions and personal traits are summarized for each occupation. "Just about the best mechanic around the plant" is a tribute worth working for. Men applying for machine work of various kinds must be men who can carry their share of the load and not just dub around in the section where several men are working, or they will soon find that the other men are going to make them anything but happy, for no one intends to carry a dumbbell.

Safety, time study, planning, purchasing sales and accounting all require specialized training as well as those in the fields of personnel and labor relations. They all for the most part should be college graduates. The machine operator, and inspector may need no more than an eighth grade education.

For engineering and research a high school student should stand in the top third of his class and have won consistently high marks in mathematics and science. World War II veterans in choosing a career in industry could profit by reading this book. Recommended for work in counseling and in vocational guidance.

—F. M. D.

GIFFORD, JOHN C. *Living by the Land*. Coral Gables, 303 Alcazar Avenue, Florida: Glade House, 1945. 139 p. $2.50.

Conservation, with special reference to use of the land, is the theme of this book. Emphasis is given to Florida, the southern United States and the Caribbean region, with discussion of the conservational and farming methods best suited to their particular needs. I like the definition of conservation which the author gives. He says that it is not merely saving and hoarding things; it is *sane use*.

Some premises set forth in the book are:

1. Trade should normally flow north and south, rather than east and west, and that it should be carried on between countries of different, not similar, climatic and botanic conditions.
2. Human resources are the greatest of all resources. Organs that are not used degenerate; hence, use is the dictator of our being. Man has to keep fit in order to survive, otherwise, he will pass into oblivion just as numberless other creatures have.
3. We are using up our timber four times as fast as it grows.
4. People cannot live anywhere continuously from generation to generation without maintaining the fertility of the soil. Humus and water are essential to soil formation and fertility.

Where is the best place to live? The author answers the question by stating it is where the Temperate meets the Torrid Zone and just under the frost line in the elevated parts of equatorial

regions. The author points out that in the thirteen southern states—Florida, Georgia, Alabama, South Carolina, North Carolina, Mississippi, Louisiana, Arkankas, Tennessee, Virginia, Kentucky, Texas, and Oklahoma—live twenty-eight per cent of the people of the United States; they have forty per cent of the nation's forests, twenty-seven per cent of the hydro-electric power generating capacity, and twenty-seven per cent of the country's mineral wealth. "In the South," he states, "we have all of the bauxite in the United States, ninety-seven per cent of the sulphur; ninety-seven per cent of the phosphates, sixty-seven per cent of the natural gas, sixty-six per cent of the crude oil and fifty per cent of the marble." There are twenty-three photographs of trees and vegetation of Florida and other surrounding areas in the book.

John C. Gifford, the author, is a recognized authority on forestry and conservation and he founded the American Forestry magazine and edited it for several years.

—F. M. D.

JOHNSON, SHERMAN E., AND ASSOCIATES. *Managing a Farm.* New York: D. Van Nostrand Company, Inc., 1946. 365 p. $2.95.

As one travels across the United States by rail, plane, or car and sees beautiful, well-kept farm homes they must realize that they may well represent a life time's work of a successful farm family that started out on good land. There is much science associated with farming and agriculture and the modern farmer avails himself of all the scientific and mechanical help that he can. Management, production, and marketing are words that help to spell success or failure on the farm. In choosing farming as either a vocation or avocation, first, the location and layout of the farm according to the type or specialty it is to be used for, is most essential. Second, perhaps there should be an analysis of the soil in order to get the best results. The farm buildings so often indicate whether the farmer is just barely making a living or whether he is making a business and profit from farming. A farm business is the farmer's productive resources and includes land, buildings, machinery, power, livestock, labor and management. There are small, family-size farms and there are farms covering several thousand acres and employing 20 or 30 men. The proper size of the farm depends on a number of factors but to a degree it depends upon the operator's ability as a manager; that is, on his ability to acquire control of the land and other productive resources, and on his planning and operation of the business as a going concern. Many farms are smaller than can be most efficiently operated by a typical farm family, and they do not provide an income of minimum adequacy for a farm family. An example given is small-apple orchard farming and how it failed in the Bitter Root Valley of Montana. Fruit, vegetable, livestock, dairying, fur animals, rabbit, mushrooms, ginseng, flowers and the general farm are some of the types discussed. Good advice given in purchasing a farm: don't pay more than the farm is worth and don't go into debt so far that there is danger of losing the farm because the required payments cannot be met on time. A scorecard for the selection of a farm is given. When a family moves from the city to the farm more time will need to be given to work and less to play and social activities. It is as interesting to plan a farm as it is the construction of a house and some diagrams of farm layouts are given. A list of farm equipment for a Corn belt farm of 200 acres and other types of farms will be of interest to those planning to operate a farm. Whether available and at what price are two questions that are timely at present. Conserving the land, farm resources, and the farm work program are other items of interest.

—F. M. D.

BLANCHARD, WILLIAM O. *Exercises in the Geography of Europe.* Boston: D. C. Heath and Company, 1946. 93 p. $1.25.

The geographic facts of a political, social and economic nature about Europe will be much better known after using this very excellent workbook. A guide to the use of the book is given for the benefit of both student and instructor. The first part of the book has exercises on Europe as a whole as to climate, relief, soils, vegetation, agriculture, minerals, water power, transportation, peoples, manufacturing, and trade. Then in the second part each country is studied through various types of exercises.

In the first exercise twenty significant facts about Europe among the continents is given and the student, in a sentence or two for each, is directed to state the most important economic consequence which might be expected as a result of the fact. The second is a map exercise to learn the size of the continent and learn to know and be able to judge distances and areas on the map.

Multiple choice, fill blank, matching, and completion are some of the objective type of exercises used. Graph paper and outline maps have been interspersed to allow the graphic outline of data. Their use will allow ready analysis of data and the building of mental map pictures.

This is an excellent work book to use in teaching students the geography of Europe.

—F. M. D.

LUCAS, JANETTE MAY, AND CARTER, HELENE. *Indian Harvest: Wild Food Plants of America.* Philadelphia: J. B. Lippincott Company, 1945. 118 p. $2.00.

The plant-food the Indians ate sprang from seeds sown by the winds and tended by the sun and the rain. But nature's crops are not without their dangers. All wild plants are not fit to

eat; many are always poisonous. Some must never be eaten raw, although edible when cooked. Some which must never be eaten at all look almost exactly like some which may be used as food. The knowledge of which wild foods might be used and how they were to be prepared was knowledge which came only through the centuries and at the cost of many lives. The Indians knew many things about plants and their uses and passed on this knowledge to the white man when he came to the new world.

The haw of the wild rose, in the spring when it thaws out is delicious and it was often eaten by hunters as they searched for game. A green pine cone is full of sugar and oil and when roasted is to the Indian child what a lollipop is to a city-dweller. The squaw who filled her cooking-pot with the sap flowing from a nearby tree, cooked her brave's dinner, also discovered a "food treat," maple syrup and sugar. The tuber of the Spring Beauty may be eaten raw but it is best boiled for about ten minutes, when it is said to taste like a potato. The Indians liked the boiled rootstock of the Solomon Seal and sometimes ate its ripened berries.

The pot-herb plants or greens were headed up somewhat by the marsh marigolds. They were gathered and boiled in large amounts by the Indians. After the tinge of red creeps up the stems of the poke-berry, it is poisonous and should not be boiled and eaten. Even when the Indians cut the very young shoots they cut them far above the ground. The young shoots were boiled and the first water thrown away, then boiled again. Accidently, the seed of poke-berry was carried to Europe but it is a much disliked plant and never used there.

Milkweed shoots boiled, then the first water thrown away, and boiled again is a delicacy. It is not that the milk is poisonous but it must be boiled out or the food will have an unpleasant taste.

What we call "common weeds" were almost unknown to the Indians, for many of our weeds came from Europe, although the importation of weeds was as unintentional as our accidental distribution of poke-berry in Europe.

Indians ate the young tender stems of the cattail, and the roots were dug as soon as ice left the water. The roots may be eaten raw and also ground into flour. The water lily—Water Chinquapin—was a source of food for the Indians; the Groundnut, a member of the pea family was one of the most acceptable foods which the settlers learned about. The peanut is the groundnut's southern cousin.

The bulbs of the wild onion were roasted and steamed in cooking pits. They also were dried and hung up in bundles for winter use. From the rose family, the Indians got over 100 different foods and fruits. Not only blackberries, but wild cherries, apples, and strawberries belong to the rose family and offer a great variety of food.

The people of Europe might profit now in knowing many food facts learned from this book. This little book would be of interest to peoples of rural areas in our own country where the people need to know more about wild food plants.

—F. M. D.

EBERLE, IRMENGARDE. *Basketful: The Story of Our Foods.* New York: Thomas Y. Crowell Company, 1946. 256 p. $2.00.

In the first part of the book, which is on wheat, the author does a great service toward the enrichment of knowledge and appreciation. She shows how we are interdependent upon people in other parts of the world. We help them and they in turn help us. We are all linked together in one great human-cultural and material-pattern throughout the world. Old world wheat helped us in the plant-breeding of wheat and our agricultural inventions and machines helped them, as well as ourselves. It was a Spanish woman from Mexico that took wheat down into Chile and taught the people how to grow it.

On the British Isles wheat bread was not known at all until the year 700. Even at the time that Queen Elizabeth reigned, and civilization had reached the height where Shakespeare wrote his great plays, the average Englishman still had no wheat at all. Even at the time that the colonists began to settle in wild, new, North America, most people had never tasted this kind of bread. So we see because of the price and difficulty of grinding the wheat only the more wealthy could afford white bread for a long time. The masses of the people soon came to associate white bread with people of wealth and social standing.

The author states, "The upper Mississippi valley grows more corn than any area of equal size in the world. The farmers sow their corn in well-fertilized, plowed soil, in long straight rows. The seed is in the ground early in March, and the ripe corn is harvested in September."

The farmers plant their corn, putting the commercial fertilizer into the ground at the same time. We know the time of planting corn varies with the latitude but corn in the upper Mississippi valley is planted in May. The ground must be warm and the danger of frost over when corn is planted. Corn was one of Americas gift crops to the world and it is now grown in Italy, Romania, Jugoslavia, Russia and other parts of the world in the temperate and torrid zone areas.

Rice is the food-grain crop of many in the eastern part of the world. There a few wealthy men own a large part of the land and sublet it to small farmers in tiny plots in return for a part of the crop they produce. These little farmers never stand a chance to lift themselves out of poverty. They have to borrow from the landowners or the mill owners to get seed rice to plant. They have to pay high interest out of the rice they grow, and this starts them off

again at the next season just as poor as before, and so they have to borrow again. This goes on in a continual life cycle. There is no system of public education as in our country and so the people have been left helpless to build up a way to a better life for themselves. They are held down by the near-enslavement of poverty such as few of us in the United States know.

Beef, fruit, vegetables, dairy products, sugar, vegetable oils and nuts are all presented as completely as the story of grain. Many interesting facts and bits of information are presented about many common and uncommon foods of man.

This is a timely book as food is now and for some time in the future promises to be the most important problem facing the world's starving millions. Certainly, far more people are conscious of the food problem—very immediate to them—than they are of the more spectacular atomic bomb problem which may be of much more ultimate significance. It is a most readable book, having a number of interesting illustrations. Elementary science, general science, biology, geography and home economics teachers will find this book a delightful reference and it will serve excellently as a source for student reports and as a supplementary reading book.

—R. J. A.

VERRILL, A. HYATT. *Strange Customs, Manners and Beliefs.* Boston: L. C. Page and Company, Inc., 1946. 302 p. $3.75.

The author of *Foods America Gave the World; Strange Animals and Their Stories; Minerals, Metals and Gems; Perfumes and Spices,* etc., has now presented us with another excellent book, *Strange Customs, Manners and Beliefs.* It is global in character and we realize that not only primitive peoples in various parts of the world, but also civilized peoples have customs and beliefs that are still difficult to account for and explain. However, many of them can be traced back to primitive ancestors; for example, certain marriage customs of today date back to marriage by capture, when a man's closest friend assisted him in snatching a wife from an enemy tribe. "Honeymoon" is a leftover from the days of marriage by capture and now while it indicates the first weeks of marriage, it was originally a period of hiding, in order that time might soothe the tempers of the outraged parents of the stolen bride.

The throwing of old shoes has had many meanings attributed to it. One version has it that this symbolizes the end of authority by the parents; another, that the shoes might have been thrown in anger during the days of marriage by capture. Carrying the bride over the threshold is said to have come from the same source, the idea being that the unwilling bride had to be carried over the threshold by force.

Probably of all the strange things told about in this book is the strange food eaten by peoples in various parts of the world. Canned rattlesnake is a regular dish in many leading restaurants in New York City and elsewhere. The big canneries in Florida find it difficult to supply enough rattlesnakes to meet the ever increasing demand. The author states that raw fish, if eaten when first caught, is just as palatable as cooked fish and he states that he doubts if one person in fifty could tell the difference between a filet of freshly caught raw kingfish or dolphin and a cooked filet, if he closed his eyes and did not smell the fishy odor.

In the chapter on Primitive Money we learn that the citizens of one vast empire, a civilized, highly cultured race of more than twenty million people, never heard of money and did not know that such a thing existed. These people never had or used money, and they did not even have a word for money in their language. They were the Inca Indians of Peru. Yet the Incas possessed vast quantities of silver and gold, and the Incan Empire was the richest community in the whole world at the time of the Spanish conquest of the Americas. Strangest of all, it was the Incas, who never knew or used money, who put the world on a gold standard. The riches in gold stolen from the Incas by the Spaniards enabled Spain to institute the gold standard, which since has been followed by nearly all nations. Verrill gives us unique stories of tatoos and taboos, charms and fetishes, deadly savage weapons, primitive games and musical instruments, burial customs, and many other age old curious viewpoints and practices of man. Many illustrations add to the interest of the book. This is a grand book for anyone to read, written in typical Verrill style. Few writers of popular science have Verrill's ability to make what they write intensely interesting and seemingly worthwhile.

—F. M. D.

GLUCK, NELSON. *The River Jordan.* Philadelphia: The Westminster Press, 1946. 268 p. $3.50.

The Jordan river has its source in four main tributaries between Mt. Lebanon on the west and Mt. Hermon on the east. Between Lakes Huleh and Galilee, a distance of ten miles, the river plunges from 230 feet above sea level to 696 feet below, then meanders on to the Dead Sea.

The Jordan river was central in the life of John, as it was in the life of Jesus, whom he baptized in its waters, and in the life of Elijah, with whom both of them were spiritually linked. To the Jordan they all three repaired at important crises in their lives, seeking solace and inspiration by its banks and in the wastelands near by.

Interesting information is given about Herod who exercised supreme power of life and death in the two provinces of Galilee and Perea during the entire life span of Jesus and John. Some further statements about the Jordan river are, "The waters of the Jordan thenceforth laved a

land, from which the Torah, the teaching of the Lord, was continuously to go forth. Palestine became spiritually what the facts of geography had made it physically, the focal point of the world, with Jerusalem its central city and the Jordan the world's central stream." "Palestine's blessing and curse lie in its geographical position which makes it a bridge between the nations. It is the crossroads on the trade routes between the east and the west."

The book is an illustrated account of earth's most storied river. The author describes the land and the people as it is now and then tells what was there and what happened in Biblical times—quoting from the Bible. The book is authorative and is based on prehistoric records and discoveries. The river, its valley, the ancient cities along its course and the events of sacred history are well integrated in one's thinking as they read and refer to the maps and fix locations in mind. I would recommend this book to the lay reader, minister, Sunday School teacher, and those interested in geography, geology, and history. This is probably the finest account that has ever been written about the best known river in the world.

—F. M. D.

FRYXELL, FRITIOF. *The Tetons: Interpretations of a Mountain Landscape.* Berkeley: University of California Press, 1946. 77 p. $2.00.

Since 1872, when the first national park, Yellowstone, was established, our system of such parks has enormously expanded. A remarkable galaxy of parks is today our heritage.

In this volume the author describes and traces the geological background of Grand Teton National Park, in Wyoming. February 26, 1929, as one of the final achievements of his administration, Calvin Coolidge signed the act that added to our federal recreational areas, Grand Teton National Park. From the east, west, north, and south, modern highways reach to their feet, where all highways must end, since to insure that the range remain as nearly as possible in its original state of wild grandeur, the framers of the park law wisely stipulated that within the park boundaries no construction of roads or hotels should be permitted.

Each year a larger number come to these mountains and become aware that only from trails can one come to know mountains and the great outdoors intimately, and to these the highways are simply places of departure.

The rugged Teton country of the park covers 150 square miles. An excellent folded map of the park is placed in the back of the book. There are eleven beautiful photographs. The park is nine miles in maximum width and extends north and south through a distance of twenty-seven miles. Its northern boundary is within a dozen miles of the southern boundary of Yellowstone National Park. The Tetons cannot be considered apart from the beautiful valley bearing the strange name of "Jackson Hole" which adjoins them on the east and provides them with a setting so nearly perfect. The master stream of all the contiguous country is the Snake River. It follows a braided course that is defined by marginal groves of aspen, spruce, and fine old cottonwoods. The Teton range is for all practical purposes an insuperable barrier, over forty miles in length; it springs abruptly from the valley and, but a few miles west of its base, attains elevations of from 9,000 to nearly 14,000 feet above the sea. It is lifted above the forests into realms of bare rock and perpetual snow and in its deeper recesses glaciers still linger. Here the beauty that lies in wooded lakes and alpine tarns, no less than the majesty of profound canyons, finds glorious expression, yet probably none will contest the statement that the superlative feature of the range is its display of peaks. Standing in single or broken rank along the full length of the range, the peaks that comprise the Tetons make an array that is truly notable.

Six of the loftiest and most distinguished mountains of the range are known as the "Cathedral Group," and consist of Grand Teton, the peak after which the park takes its name; the South Teton, Middle Teton, Mount Owen, Teewinot, and Nez Perce.

The Teton range is of the "fault block" type and is geologically still very young. Since its uplift, the block has undergone ceaseless sculpturing by streams, glaciers, and other natural agencies, which have carved it into its present rugged aspect.

The waterfalls, lakes, avalanches, clouds and storms of the Tetons are discussed. Travel to the Tetons is largely confined to the summer season, which at best is brief, from June until the latter part of August.

—F. M. D.

SMITH, CHARD POWERS. *The Housatonic.* New York: Rinehart and Company, Inc., 1946. 532 p. $3.00.

Of the Rivers of America series of books—this is the story of the Puritan river, the Housatonic. It rises in the Berkshire hills and flows through western Massachusetts and Connecticut. Geologically it is an old river and one of its upper tributaries was stolen by the Hudson and it became a smaller river. The Indians, Mohicans, Pequots and other tribes were there when the Puritans came. A struggle for survival ensued, with the Puritans' great faith in themselves and their idealism winning over great hardship and difficulty. Agriculture was the main occupation, then with the Industrial Revolution came an industrial period to this valley. With sufficient wealth and leisure, more time was given to education, law, medicine, literature, and intellectual pursuits. Out of this came the great age of literature and writers that has scarcely been equalled or surpassed anywhere in the

United States. A few of the great and famous names that stand out are Holmes, Longfellow and Hawthorne. Before them were the Beechers, Edwards and many others. The author shows the evolutionary history of this valley in the phrase "the rise, decline and fall of Berkshire." With the westward movement many moved west, new immigrants moved in from Europle. People spend part of their time in New York and often spend the summer in the valley. Here the old and the new are becoming one people.

—F. M. D.

PEATTIE, RODERICK (Editor). *The Pacific Coast Ranges.* New York: The Vanguard Press, 1946. 402 p. $3.75.

In the introduction, information about each of the ten contributors is given and in the content page the parts written by each are carefully designated. For instance, I was interested in the geologic story of the coast ranges so I read what Daniel E. Willard had written on that. Next, of interest to me, was the geographic description and climate by Richard Joel Russell. "Considering the Lilies," and other topics on flowers by Donald Culross Peattie struck my fancy.

Yes, and in these times of scarcity of homes when "man hath not where to lay his head," I read all about the big timber—pure stands of Douglas fir and other fine timber. "The first species, one of the true firs grows to immense size and is commonly twenty-seven feet in circumference, six feet above the earth's surface. They rise to a height of two hundred and thirty feet, and one hundred and twenty feet of that height without a limb. We have often found them thirty-six feet in circumference at a point beyond the reach of an ordinary man." In discussing the conservation of our forests it is stated about Gifford Pinchot, "He became not only a forester, but a national forester. And so zealous a national forester did he become that he got himself fired by President Taft for too much competence." A depression and a recovery in which there was a great timber boom is described:

"McKinley in the White House,
Bryan on the fence,
Tryin' to make a dollar
Out-a thirty-nine cents."

The Republicans from the Atlantic to the Pacific had shouted, "*The way to resume, is to resume.*" And it worked, the recovery was on and it was further signalized by the modern marvel of elecricity. The topics "snow on the mountain," and "straw hat season with overcoats" are quite picturesque and revealing as to the climate. In the latter topic is this information: "Cool summer climates extend along the entire west coast of the United States—San Francisco is ordinarily the coolest major city in the United States during July and August. Hardly a night occurs when one ventures forth without a topcoat. During many July and August days one sees straw hats, in deference to summer, worn in combination with overcoats, demanded by bodily comfort. Only the unwise leave the sweltering East without packing heavy clothing for a summer on the Pacific coast."

The thousand-year-old groves of red wood and the "big trees," the Sequoias, are eloquently described. The description of the herbs and flowers and the geologic history of the trees is of equal interest and appreciation to the reader. This book can take its place along with the many other excellent books of a geologic and geographic nature published this year.

—F. M. D.

WHITE, VAUGHAN. *Our Neighbors, the Chinese.* New York: Rinehart and Company, Inc., 1946. 267 p. $2.75.

Vaughan White was born in Canton, China, where her father was a medical missionary. All of her early education was received from Chinese tutors and from them she learned to speak five dialects. Miss White attended Holyoke College and received an M.A. from Columbia University. In 1931 she was assigned to travel all over China and study conditions for the Rockefeller Foundation. During this period Miss White wrote for many magazines and newspapers about China and, more particularly, the position of women in the Orient.

"Daughters of the Revolution" is the seventh chapter in the book and in it one can learn much of interest about Madame Chiang Kia-shek. Then next in order of interest is the story of the life of Chiang Kia-shek and his struggle to maintain unity in China.

"The government under Chiang has developed strong facist characteristics. Judged on the basis of what has happened, it might rightly be called an autocracy maintained by force, with active suppression of all elements contradictory to the existing order. China certainly does not function as a democratic state. But in making this criticism one must hold in mind that the spirit of the people is a very different thing from their government. The state is not democratic because the people have not had direct representation. But the people themselves have been democratic for thousands of years."

The Soong family, Sun Yat-Sen, the philosophy and life of the peasants of China, are some of the worthwhile highlights of the book. The author compares the women, government, and countries of China and Japan and attempts to show how, and wherein they are different.

On page 231 an incident of the war is given. "The Chinese were faced with opening the floodgates in order to drown 5,000 Japanese farther down the river. But there were also 100,000 Chinese in the same area who would be drowned

or left homeless. The Chinese did not hesitate. The floodgates were opened."

The United States and other countries of the world can well afford to be vitally interested in the present political, social and economic life of China. We may add "here is a record, written without sentimentality, but full of sentiment, that sets forth with sympathy but no bias, the startling extremes of Chinese life." Students from China study in the United States and then return to China and try to make certain beneficial changes and improvements but probably the invasion of China by the Japanese has effected more definite, lasting changes than any other factors in many years. No peoples are more peaceful than the Chinese yet how turbulent has been their history—their peace and welfare seems ever at stake and must be guarded most carefully. To simplify their language and to educate them and remove illiteracy, would be one of the first steps toward unifying and improving China. Their common foes are illiteracy, poverty, and disease. Better transportation facilities, dams to prevent floods, and increased production through scientific agriculture can and will be realized in China before many years.

—F. M. D.

Steel, Byron. *Let's Visit Mexico: A New and Practical Guide.* New York: Robert M. McBride and Company, 1946. 425 p. $3.00.

Mexico, with its varied culture, climate and scenery lures many tourists there every year. It is the wise tourist that plans his trip in advance very carefully and to do this he will need an up-to-date guide. *Let's Visit Mexico* is just that. At the outset, the volume tells what the tourist should know before leaving, about identification cards, health precautions, customs regulations, automobile permits, and equipment, money, food, and so forth.

In the appendix is given useful expressions in Spanish, a calendar of fiestas, significant dates in history, distances of tourist towns and cities from centers such as Mexico City and others, shopping in Mexico, and suggested itineraries. He describes a bullfight in Mexico City's huge steel stadium with a seating capacity of 25,000. Vera Cruz, on the coast, is the oldest of Mexico's colonial settlements. It has a tropical climate and high humidity. A trip from Vera Cruz to higher elevations would be of interest noting the difference in temperature, rainfall, and vegetation.

Mexico, "the ageless land of Manana," is about three times the size of Texas. It is a land of sharp contrasts. Its surface alternates between towering mountains and broad plateaus.

A short drive from a town may lead you to the edge of an unexplored jungle. The highways are good between the large cities but in outlying areas the roads are not in good condition to drive over with a car, as one learns from reading the guide. The Yucatan peninsula is a prehistoric land. It was here and in the northern part of Guatemala that the Maya Indians reached a high degree of civilization.

The guide will prove most useful to anyone planning a trip to Mexico. They will want to have it along with them "to read as they run" and get information and advice quickly from its pages. In the field of social science, history, and geography the book is invaluable. The casual reader will also enjoy reading the book. It contains a wealth of route maps, street maps of important cities, and many striking photographs.

—F. M. D.

Haynes, William. *Southern Horizons.* New York: D. Van Nostrand Company, Inc., 1946. 316 p. $2.75.

The author made a scientific survey of the south and found it ready for new developments in the post-war era. A crescent from Corpus Christi northeast on through the other southern states is rich in mineral resources and especially resources of interest to the chemical industry—oil and gas, sulphur, magnesium and aluminum. Iron, coal, and limestone along with many forest and agricultural products are also of interest to the industrialist. Hydro-electric power is one of the south's great natural resources. Hence, the author states, "the Tennessee Valley Authority, the largest producer of electrical power in the south, has enormous potentialities—for or against southern industry. Specifically, the TVA may well determine the future of three of the south's greatest industries, the old, well established hydro-electric power and fertilizers, and the very new, very potential aluminum. These industries are rooted in three most important southern resources: water power, phosphate rock, bauxite ore. Their products—energy, plant-food, metal—are so basic that they will have a tremendous influence upon the future development of the entire south." Further discussion of the TVA is of interest. He reviews the work of Herty, the chemist who did so much toward making paper from quick-growing southern pine. Haynes is optimistic about the southern paper industry and says there is no ceiling on its future expansion. He states that, "at the Kraft mill in Alabama where they jealously guard their secret know-hows, I was told they use up to thirty per cent of hardwood and get, they claim, a better paper." The southern paper industry is beginning to turn its own wastes into new wealth, and will bring to the market at an opportune time lignin, furfural, tall oil, and turpentine.

William Haynes has written a number of other books including *The Chemical Age* and *The Chemical Front.* Chemists, economists, and those in the field of science in general will find the book up-to-date and full of scientific and industrial information about the south. The horizons of the South are full of promise.

—F. M. D.

WALDECK, JO BESSE MCELVEEN. *Jungle Journey.* New York: The Viking Press, 1946. 255 p. $2.50.

Theodore J. Waldeck, an explorer, and his wife went to explore jungle country about the source of the Cuyuni River in British Guiana, South America. They were very careful to plan their trip, as to selection of food and equipment—a supply to last them and the crew a year. The first night in the jungle convinced the explorer's wife that she was scarcely equal to the task set before her, and the next night she retired early, but always in the morning was eager to be on the way. A hundred stretches of rapids had to be overcome in progressing upstream. Falls, rapids, black ants, malaria, and a mutinous crew were some of the troubles that beset them. They came to know the Arawak, Akawai, and Carib tribes of Indians. The author states, "In a primitive land where no modern devices whatever are known, it is amazing to find how much labor is required in the making of so simple a thing as bread, the weaving of so simple a thing as thread, and the making of so simple a thing as a hammock. The preparing and baking of bread was a full day's work for several women. The weaving of a few balls of thread required months, while the making of a simple hammock required many years." The explorer and his wife finally took leave from the Indians and the jungle. They had learned much about the customs and superstitions of the Indians. The book is rich in information and a pleasure to read.

—F. M. D.

FANNING, LEONARD M. *Our Oil Resources.* New York: McGraw-Hill Book Company, Inc., 1945. 331 p. $4.50.

In the preface of this book it is stated "that two-thirds of all war materials shipped to the fighting fronts during the second World War has been petroleum in one form or another. This country has supplied some 90 per cent of the petroleum requirements of all the United Nations—oil resources figure high in the counsels of nations these days." An accounting of our oil resources is given not alone in terms of geological knowledge but also in terms of human resources—engineering, and scientific learning and application, and private initiative and incentive.

We have in the United States only 15 per cent of the world's oil reserves; the eastern hemisphere has 65 per cent; western hemisphere 35 per cent. We should have started long ago to conserve our oil resources for when we have to get it from oil shale and other sources we will have it only at much greater expense and effort. It is an excellent reference book and full of tables and statistical information.

Eighteen outstanding authorities, and oil company executives, have contributed to this impressive symposium. Our petroleum industry started only 85 years ago with a shallow well in Pennsylvania, and lamp oil was its main product. No industry is more competitive than the oil industry.

One contributor states that the task of oil finding in the United States becomes increasingly difficult and that we have not sustained the effort to find oil which we once put forth because of certain hindrances.

In the back of the book is a list of motion picture films available from the oil industry which can be used to advantage to supplement much of the material in the book.

—F. M. D.

HANCOCK, RALPH. *Opportunities in Latin America.* New York: Duell, Sloan and Pearce, 1946. 278 p. $3.00.

For many years the author was a resident news correspondent covering the Latin American countries, and was, for several years, director of publicity for TACA Airlines. He is well informed on political, economic and social problems of the present, and the future prospects of Latin America. The book makes one think and realize changes are in store for all of us in the Western Hemisphere and these changes and new adjustments may come quite rapidly as people become better educated and more internationalized.

The countries of Latin America as a result of the war are becoming more industrialized, but with industrialization a middle class of people is beginning to emerge who can afford motor cars, radios, electric refrigerators and sewing machines. They now have money with which to buy these things, made from profits from the war. But lack of production even to meet our own needs may lose us not only much at home but in Latin America. A year before V-E Day, British commercial scouts were already launching their "Buy British" campaign in Latin America. The rapid post-war reconversion of other European countries (particularly the neutrals) to consumer goods, and their race for the Latin American markets long before V-J Day, is the European imponderable for American exporters. Also, we must realize Latin America means to be industrially independent to a greater degree as soon as possible. We know they lack coal and iron, and there are many handicaps, but competition with Europe and the fact Latin America will gradually become more productive and industrialized cannot be overlooked by us.

Each country is taken up and discussed separately. Sections of the book are also devoted to transportation, communication, industrial power, agriculture, manufacturing, mining, petroleum, forest products, fisheries, travel and trade. Teachers and students of geography, history, and political science need to read this book and shall I add—government officials in Washington.

The author states that "civilization in the countries south of us runs the gamut from Stone Age to ultramodern. There are Latin Americans who do not even know that the country they are in is called Brazil or Ecuador, and much less that there is a country beyond the sea called the United States". There is a strong, cultured upper class of people, a large lower class, and a rather small middle class that has shown signs of increased growth and power during World War II.

—F. M. D.

Stokley, James. *Electrons in Action.* New York: Whittlesey House, McGraw-Hill Book Company, 1946. 320 p. $3.00.

Electrons in Action is a clearly written, nontechnical book that laymen, science teachers, and science students can easily read and understand. Mr. Stokley is a special writer and lecturer for the General Electric Research Laboratory. He is author of the two popular science books *Stars and Telescopes* and *Science Remakes Our World.* And as he points out and emphasizes throughout this book, electrons have and are continuing to remake our world.

The author explains what electrons are, how they are set free, and how they are put to work. Their many applications are then described. The elements and characteristics of electron tubes of various kinds and uses are described. Frequency modulation and television are explained.

Electronics play an important part in industry, in communication, in medicine, in lighting, in sound production, in welding, heating, plastic molding, in textile mills, color printing, in precipitators, analyzing metals, measuring, counting, high speed photography, uses in war, and so on. There are also excellent chapters on atomic research, radar, IFF, BTO, and Loran.

This book is recommended for the high school science library, for any science teacher or student who wants to read a book that explains the field of electronics in a most understandable and interesting manner.

—G. B. K.

Pendray, G. Edward. *Men, Mirrors, and Stars.* New York: Harper and Brothers, 1946. 335 p. $3.00.

Popular and scientific attention is now centered on the atomic bomb, but the completion of the 200-inch Mt. Palomar telescope in 1947 may also open up new vistas not yet dreamed. The building of the glass giant of Palomar will mark the completion of an engineering feat probably unexcelled, taking into consideration technical skill and costs, and acclaimed by many as equal to the construction of Boulder Dam or the Panama Canal.

Men, Mirrors, and Stars is an informative, popular book about astronomy, about telescopes and the men who make them. Woven around this historical slant, the whole history of astronomy is interestingly unfolded, beginning with the early Greek astronomers, then Galileo, Copernicus, Kepler, Newton and the host of other names that have become an integral part of astronomy's hall of fame. The author emphasizes the part that instruments have had in the accumulation of men's vast astronomical knowledge. And American astronomical instrument makers may well be proud of the part they have played in making America preeminent in the field of astronomy. The Clarks of Cambridgeport, Massachusetts, the Brashears of Pittsburg, the Warners and Swaseys of Cleveland, and Corning Glass of Corning, New York, are names that stand out as makers of the "eyes of the universe."

The appendices lists the world's largest telescopes and where they are found, together with the history of some modern observatories in North America and the Southern Hemisphere. The book is illustrated with many interesting photographs and line drawings.

What of the future? The 200-inch Palomar will cost about $6,000,000 and the completed mounting weighs about 1,000,000 pounds. Its light-gathering power is 800,000 times that of the unaided eye. It enlarges the present visible universe some 30 times, and reaches out into space the magnificent, terrifying distance of 1,200,000,000 light years. It now seems possible that a 300-inch telescope is mechanically possible to build if some way can be found to finance the total costs of probably $15,000,000. It would reach out photographically 2,700,000,000 light years—almost to the estimated universe edge of 3,000,000,000 light years. It would make possible a study of the major portion of the estimated 500,000,000,000,000 island universes. The late astronomer, Ritchey, had made some plans for a supertelescope of 315-inches in diameter with a theoretical magnifying power of 22,500 when applied on objects such as the moon, planets, and nebulae, and 37,000 when used to photograph stars. It would make possible the study of details of the moon 70 feet in diameter and on Mars less than 2 miles in diameter.

—C. M. P.

Galt, Tom. *Volcano.* New York: Charles Scribner's Sons, 1946. 102 p. $2.00.

The reviewer has read a number of books recently on volcanoes, particularly about Paricutin, but none have described so vividly the volcano and its effect upon the people there. We see the volcano through the experiences of a growing boy, Perico. "I saw it," panted Dionisio. "A fire monster leaping out of the ground! Bright flashes and showers of sparks, so that it blinds you to look! And I smelled sulphur!" The people fled to a high hill and all night they crouched together, pulling their blan-

kets round their shoulders. All night the noise of the explosions deafened them, and the earth shook more and more violently All night they watched that spot in Dionisio's distant cornfield where the fire flashed brightly, shooting up showers of livid red and orange sparks. A scientist came and as they all watched the volcano, they looked into the serious face of the scientist and Dionisio put into words the thought of them all, raising his voice to be heard against the noise of the explosions. "What is it?" The scientist answered, "It's a volcano all right. A brand new volcano." Strange people who came from the city to see it would murmur, "How beautiful! How beautiful it is!" Perico felt puzzled. How could anyone see beauty in a thing that was doing so much damage? And still there was the question that no one seemed able to answer. "How were the people of the village going to live?" One is impressed with the size of the volcano and the destruction it wrought. The reader is left wondering just what did happen to the town of San Juan.

—F. M. D.

COLEMAN, SATIS N. *Volcanoes, New and Old.* New York: The John Day Company, 1946. 222 p. $3.75.

This is a non-technical story of volcanoes. A visit to the new volcano Paracutin aroused the author's curiosity, and stimulated much reading on the subject of volcanoes in general. The author states that the study of volcanoes is the key to understanding the constitution of the earth; they furnish us our only opportunity to observe the formation of original rock material from the earth's interior; and they also have given undoubted evidence of great hidden energy which man must learn either to avoid or redirect. Therefore, to approach the study of the earth through the direct evidences offered by volcanoes is logical, and a greater interest in geology follows naturally from an interest in the behavior of volcanoes.

The book contains 97 illustrations and two maps. The causes of volcanoes, materials, varieties of volcanoes and craters, and the distribution of volcanoes throughout the world briefly summarizes the content page.

Paracutin, first erupted February 20, 1943. It is the youngest volcano in an inhabited country, and it has had more careful scientific observation than any other volcano of modern times. It is located in the southern part of Mexico.

The author quotes Dr. Frederick H. Pough, curator of geology and minerology of the American Museum of Natural History, New York, as saying, "Perhaps Paracutin will continue for many years; perhaps it will die down shortly. When it is finished it will never erupt again, for the cinder cones which dot the countryside are clearly the products of a single, continuous eruption. So while it is active it should be studied in the greatest detail, and it is well worth the visit, despite the many inconveniences, for any one can get there."

Thirteen months after Paracutin's appearance an extraordinary eruption of Vesuvius in March, 1944, with British and American soldiers on the ground to add greater excitement to the event, provided further stimulation to scientific interest, as well as more data for the records.

The republic of El Salvador is the most volcanic country of all the Americas and also the smallest, being about the size of Maryland. Ecuador is more subject to volcanic disturbances than any other South American country.

Paracutin and Vesuvius are only two of the many volcanoes photographed and described in this John Day 20th anniversary book.

—F. M. D.

YATES, RAYMOND. *The Weather for a Hobby.* New York: Dodd, Mead and Company, 1946. 172 p. $2.75.

Although Mark Twain was about right in saying that man could do little about the weather, man has been an amateur observer and forecaster of weather from early times. Much of this observation has been, and still is, pursued without resort to instruments of any kind. However, instruments, even homemade ones, can greatly increase the accuracy of observation and forecasting so that the beginner can soon surpass men of years of experience who have never used instruments.

Certainly weather prediction at home can become a fascinating hobby, as it has for many a youngster. It is not a difficult hobby and some proficiency can soon be attained.

Weather for a Hobby tells how to make at small cost and little mechanical skill instruments needed to study and predict the weather. Illustrated with diagrams and cross-sectional drawings, details of construction are given for making instruments to measure cloud height, cloud drift, wind direction, wind velocity, pressure, temperature, and precipitation. Most of the material can be obtained from around home or from the ten-cent store.

—R. J. A.

BEDELL, A. L. *An Album of Celestial Photographs.* St. Louis: A. L. Bedell, Box 1447, 1946. $1.00.

This is a collection of 65 unusually fine celestial photographs, most of them 8 x 10 in size. They are reproductions from photographs taken at the Yerkes, Lick, Mount Wilson and Harvard observatories. A brief description with proper accreditment is given for each photograph.

This is an excellent collection for use by any science teacher: elementary, junior high, secondary, astronomy, or physical science survey.

—C. M. P.

Bedell, A. L. *Astronomy for Busy People.* St. Louis: A. L. Bedell, Box 1447. Unpaged. $0.60.

Most beginners, as well as those having some knowledge of astronomy, will welcome this concise accumulation of astronomical data most frequently used by beginners and written in a style readily understood. It includes a circular sky map and thirteen other star maps. Topics discussed include: the celestial sphere, right ascension and declination, meridian, the sky's apparent motion, earth's annual rotation, ecliptic, the sun, moon, planets, retrograde motion, the constellations, star distances, kinds of stars, milky way, nebulae, comets, meteors, eclipses, rotation and revolution of the earth, the phases of the moon.

Elementary teachers, general science teachers and the youthful would-be observer of the sky will find this a useful little book.

—C. M. P.

Duncan, John C. *Astronomy.* New York: Harper Brothers, 1946. 500 p. $4.50.

First published in 1926, this fourth edition brings the textual material up-to-date. It is intended as a general view of astronomy and is recommended as the initial text in the field, or as an excellent reference book for physical science survey courses. A total of 318 illustrations and photographs supplement the textual material. Several star maps and tables are also included. Undoubtedly this new revision will have even greater usuage than the deservedly popular earlier editions.

—C. M. P.

Whipple, Fred. *Earth, Moon and Planets.* Philadelphia: The Blakiston Company, 1946. 293 p. $3.00.

This is one of the Harvard books on astronomy. This series as a whole comprises, without question, the best material that has been written in the field of the oldest of the sciences. They are non-technical in style and can be easily read and understood by any layman. All of them serve excellently as references in astronomy and physical science survey courses, for any science teacher—astronomy, physical science survey, general science, secondary, or even elementary science. Each book has many excellent photographs and illustrations, and an appendix having much useful information. Each author is an authority in the field in which he writes.

Earth, Moon and Planets presents information about the atmospheres, composition, conditions, satellites, rotation, revolutions, the discoveries of the later planets, possibilities of life on planets other than the earth, and so on. There are chapters on how the solar system holds together, and weights and measures. Three chapters are given over to a discussion of the moon. The origin and evolution of the moon, earth and other planets is discussed. No presently advanced theory of solar system is completely adequate. But all evidences points to an origin in the sun itself or from some similar star. The planets were once very hot, far above the temperature of melting rock. The planets grew from a fairly rapid condensation of material, not from a slow accretion process. If a stellar collision is required to produce planets, only a few systems such as ours are likely to exist among millions of stars. If a single star, unaided can generate a system of planets, the number of planets could be enormous. Two possibilities exist for the origin of the moon, with little choice between them. The moon may have been once a part of the earth or it may have come into existence in a manner at the same time as the earth, but was never actually attached to it

—C. M. P.

Goldberg, Leo and Aller, Laurence H. *Atoms, Stars, and Nebulae,* Philadelphia: The Blakiston Company, 1945. 323 p. $3.00.

The first part of this book explains how the astronomer measures the dimensions and distances of stars and nebulae. Atoms and molecules are the stellar building blocks. The surface temperature of some stars is as much as 50,000 degrees as compared with the sun's 6,000 degrees. It has been estimated that the internal temperature of some stars may reach 35,000,000 degrees as compared to the sun's 9,000,000 degrees.

Antares has a radius 330 times and a volume 36,000,000 times that of the sun, yet it only weighs about 30 times as much. On the other hand, a white dwarf known as Van Maanen's star has a volume about three ten-millionths that of the sun and a density of probably seven tons per cubic inch.

Sixty-one elements found on the earth have been found in the sun. However, 81.7% of the sun's volume is hydrogen and 18% is helium. The composition of other stars is seemingly very similar.

Whence the sun's and stars heat? It is agreed that it is a process by which mass is converted into energy. But how? The Bethe carbon cycle explains fairly well the luminosity of the sun and similar stars. But even it encounters a number of difficulties. It seems to encounter even greater difficulties in accounting for the energies of both cooler and hotter stars.

The origin, evolution, age, and probable fate of the stars and nebulae are as yet but little glimpsed. A unification of knowledge of such diverse objects as dwarfs, giants, supergiants, pulsating and variable stars, and supernovae must first be made to fit them into a coherent picture. We know so little!

—C. M. P.

Dimitroff, George Z. and Baker, James G. *Telescopes and Accessories.* Philadelphia: The Blakiston Company, 1945. 309 p. $3.00.

This book describes astronomical instruments and their uses. While non-mathematical, the

book is somewhat more difficult reading than the other books in the series. It does answer the questions of how astronomers have found out so much about the stars. Amateur telescope makers will gain many useful ideas. Many illustrations and photographs supplement the textual material. Pictures and descriptions of famous telescopes are interesting. The book surely makes for a clearer understanding of the field of astronomy—an understanding the layman can obtain in no other way.

—C. M. P.

CAMPBELL, LEON AND JACCHIA, SUIGI. *The Story of the Variable Stars.* Philadelphia: The Blakiston Company, 1945. 226 p. $3.00.

Variable stars vary not only in light intensity but also in spectral type, apparent diameter, color, temperature, atmosphere, and the like. The most spectacular change in the brightness of a star is probably the tremenduous outburst of Tycho's Star in 1572. It became even brighter than Venus, probably increasing in brightness at least 20 magnitudes or 100,000,000 times its original brightness.

The total number of variables found to date is nearly 20,000. They have been classified into the following main classes: cepheids, long-period, red-giants, novae, nova-like, eclipsing, and erratic.

The Cepheid variables are of great significance because by determining their apparent brightness and knowing their absolute brightness their distance can be easily determined. They serve as measuring rods to determine the size and shape of our own galaxy, as well as the distance to stars.

The red variables can be divided into red dwarfs and red giants. The red dwarfs are smaller than our sun and of much higher density. The giants are enormous in size and of great brillance.

Nova are stars that, for some reason, explode. Many have been observed in recent years, one of which has exploded three times since 1863. Also about 30 supernovae have been observed. These are found in galaxies outside our own and represent tremendously greater explosions than novae. The nova of 1572 and 1604 were really supernovae.

Eclipsing binaries (double stars) are important in determining the size, masses, and densities of binary systems.

—C. M. P.

WATSON, FLETCHER, G. *Between the Planets.* Philadelphia: The Blakiston Company, 1945. 222 p. $3.00.

This book describes the asteroids or little planets, the comets, meteors, and meteorites.

The first asteroid was discovered in 1801. About 6,000 have since been discovered and a large number is added yearly. Their orbits are much more elliptical than the orbits of the planets. The nearest approach tc the earth that has yet been observed (an asteroid) was estimated to be a little less than three times the distance of the moon.

Comets have long been observed but their origin is as yet really unknown. They have very elliptical orbits. The periods of revolution vary tremenduously. Some have very short periods; others must have extremely long periods. The best known comet, Halley's, has a period of a little over 75 years.

Every day billions of tiny particles strike the earth, but most of them burn up before going through the earth's atmosphere. This is really quite fortunate, for otherwise the earth might have never been an abode of life. An unusually heavy shower of meteors was visible in the Americas on November 12, 1833 (twenty a second or more). A rather heavy shower was visible in Europe on October 9, 1933 (350 a minute).

About 1,400 meteorites have been found. It is estimated about 2,000 fall on the earth each year, 25 in this country. The largest known meteorite, weighing about 60 tons, is in southwest Africa. The second largest, found in Greenland, weighing 33 tons, is in the Hayden Planetarium in New York City. Meteorites have produced several large craters upon striking the earth, the largest and most notable being Meteor Crater in Arizona. In composition they are classified as metallic, stony-iron, or stony. They consist of elements common to the earth, but no new elements have been discovered in them. Their exact age and origin are not absolutely known, but in age they may approach that of the earth.

—C. M. P.

SHAPLEY, HARLOW. *Galaxies.* Philadelphia: The Blakiston Company, 1945. 229 p. $3.00.

Although dimly glimpsed but suggested by Kant nearly two hundred years ago, it was not until the present century that the existence of galaxies outside our own was established and verified.

The Star Clouds of Magellan, distant some 75,000 light years, are closest to our galaxy. Visible only from the southern hemisphere, their study, mainly by two American observatories, was long delayed. In the Large Magellanic Cloud is S Doradus, a hundred times as bright instrinsically as the great cluster in Hercules. We have nothing like it in our galaxy. It is a supergiant variable, nearly 200 light years in diameter and a luminosity averaging about 500,000 times that of the sun.

Andromeda provides the only opportunity most observers will ever have of seeing an island universe with the naked eye and looking a distance into space from which the light started probably 750,000 years ago. The great Messier 31 nebula in Andromeda, a spiral type, has contributed much information because of its novae, supernova, Cepheids, high radial speed, and spectroscopically determined rotation. There are from 12 to 15 galaxies within a million or so light years of us.

The red shift in light from distant stars indicates they are moving rapidly away from us—in fact so fast, that many scientists are sceptical as to what is really happening. The speed of the galaxies is such that the radius of the universe seems to be doubling every 1,300,000,000 years. Is this seeming increase real? Much more knowledge remains to be revealed than what man with his puny brain has as yet attained.

—C. M. P.

Stimpson, George. *A Book About a Thousand Things.* New York: Harper and Brothers, 1946. 552 p. $3.50.

George Stimpson was the originator of the first radio quiz program, starting it in 1924 on station WRC in Washington. He helped edit *The Pathfinder* for ten years and is a former president of the National Press Club, the highest tribute that can be paid to a Washington newspaperman. He has answers to questions in this book from almost every field—history, literature, geography, astronomy, science, law. There are questions relating to the wind and weather, to maps and gloves; questions as to the origin of words and about animals.

An example of some questions on animals are: Should a live rabbit be lifted by the ears? What does range mean? Information of interest about the antelope is given. Can a giraffe graze? Do gorillas beat or drum upon their breasts?

Other questions of interest: How did the word "news" originate? Did Harvard men found Yale? What queen of England was never in England? What was the longest reign in history?

Examples of interesting facts learned from the book are: honey bees are not native to America. Cleopatra was Greek by ancestry, and Egyptian only by birth. The Yellow River is popularly known as China's Sorrow because of its devastating floods. "Marry in May and you'll rue the day," is an old proverb, and a gruesome but anciet Scottish saying runs: "From the marriages in May all the brains die and decay." But "Prosperity to the man and happiness to the maid when married in June," was a proverb in ancient Rome.

Why is "colonel" pronounced "kurnel"? and why is "Jno" used as the abbreviation of "John"?

The classic question and answer form is used and the book might be used as a source of questions for "fun" parties in school clubs, and other occasions. The author states in the preface that he has read the Bible through eight or ten times and has written, *A Book About the Bible. A Book About a Thousand Things* has been chosen as a Book-of-the-Month Club.

—F. M. D.

Reager, Richard C. *You Can Talk Well.* New Brunswick: Rutgers University Press, 1946. 312 p. $2.50.

This seems to be an excellent book both for classroom use and for any man or woman desiring to increase their speaking abilities and thus to increase their personal efficiency.

You Can Talk Well was used during the war for the training of military personnel. It discusses in addition to public speaking (causes of ineffectiveness, speech selection, organization and plan, your voice, vocabulary, platform manner, and so on) such things as the presiding officer, the banquet or dinner meeting, presentations, selling and sales efficiency, the interview, the written report and paper, radio speech, telephone speech, your conversation, and so on.

For their own self-improvement and advancement, science teachers could probably not own and use a more valuable book.

—G. E. D.

Mills, John. *The Engineer in Society.* New York: D. Van Nostrand Company, 1946. 196 p. $3.00.

The Engineer in Society might as appropriately been called *The Scientist in Society.* Based on the author's long experience with industrial scientists, the book presents a clear, challenging, far-sighted survey of the problems that face the engineer in a society that caters to the businessman and financier, the politician and the statesman. The engineer and the scientist have not received their due share of credit. This is in large part due to the modesty but also to some degree to the engineer's idealism. Nor have the engineer and the scientist functioned in society as they should.

Most of the treatise is provocative, challenging, the result of much analytical thinking. Mills believes that most persons can be divided in S or D classifications. The former looks for similarities in making comparisons; the latter looks for differences. Both approach problems differently and both have their especial riches in the word. The D's are the go-getters and drivers; the S's the philosophers, creators, and craftsman.

The author devotes considerable time to the importance and quality of aptitude tests. He devised an aptitude test for engineers that was productive of unusually good results. Definitely some individuals are of the research type, others of the executive type. It is often a great loss when a good research worker turns executive.

Salaries of engineers and scientists are far below what they should be. Something needs to be done about this, and in the final analysis it will have to be done by the groups themselves, mainly through organization, but not through unionization.

Women have not succeeded very well in engineering work. Often successful in biological research, they have more often failed in engineering in the physical sciences.

The last part of the book is devoted to the need of exposition for engineers—the need for both public speaking and writing technical and popular

papers. Engineering schools are neglecting this most important aspect of engineering education. The author discusses the values of persuasive exposition and the need of reader consciousness on the part of the writer. He says, "Clear thinking, good intentions, simple sentences, their rearrangement with reference to the reader over one's shoulder and then knowing when to quit—that is the sequence of desiderata and techniques which I recommend for purposeful exposition."

The author recently retired as Director of Publications at the Bell Telephone Laboratories after being associated with the Bell Telephone Company for many years. Many readers will recall a number of his books such as *Within the Atom, Signals and Speech,* and *Electronics Today and Tomorrow.*

—S. M. A.

SHAPLEY, HARLOW, RAPPORT, SAMUEL AND WRIGHT, HELEN (Editors). *A Treasury of Science.* New York: Harper and Brothers, 1946. 772 p. $3.95.

A Treasury of Science is intended for persons without specialized knowledge in science; the purpose "to give some realization of how the scientist works, of the body of knowledge that has resulted and of the excitement of the scientists' search." Much time was spent in first working out a plan to suggest "the unity, the architectural quality of science. The plan is evident from the titles of the major parts: Science and the Scientist, The Physical World, The World of Life and The World of Man. The subdivisions carry through the plan in what seems a logical order. Then followed a period of over a year in which several thousand books and articles were examined." Thus the goal of this volume is a contribution toward the integration of science. It was found possible to avoid translations almost completely. While more emphasis is placed on modern science, there are certain selections from earlier scientific writings e.g. Copernicus, Galileo, Miller and so on.

The book may be opened at random or read methodically from beginning to end. While not encyclopedic in nature, it does have definite value as a reference book and gives probably the finest all-over view of science that the reader can find. A section of some seventy pages on atomic fission brings it completely up-to-date.

An idea of the selections, scope and comprehensivenes of *A Treasury of Science* may be gained from a list of some of the selections and their contributors: *The Aims and Methods of Science* by Roger Bacon, Albert Einstein, Sir Arthur Eddington, Ivan Pavlov and Raymond B. Fosdick; *A Theory that the Earth Moves Around the Sun* by Nicholas Copernicus; *Proof that the Earth Moves* by Galileo Galilei; *A Young Man Looks at Rocks* by Hugh Miller; *Geological Change* by Sir Archibald Geike; *Discoveries* by Sir Isaac Newton; *The Discovery of Radium* by Eve Curie; *The Chemical Revolution* by Waldemar Koempffert; *Science in War and After* by George Russell Harrison; *Parasitism and Degeneration* by David Starr Jordan and Vernon Kellogg; *The Courtship of Animals* by Julian Huxley; *Biography of the Unborn* by Margaret Shea Gilbert; *You and Heredity* by Amran Scheinfeld; *Leprosy in the Philippines* by Victor Heiser; *Thinking* by James Harvey Robison; *Nuclear Physics and Biology* by E. O. Lawrence; *Atomic Weapons* by J. R. Oppenheimer.

High school science libraries, science teachers, science students and laymen will find this one of the finest sources on the work and accomplishments of scientists to be had in the space of a single volume.

—C. L. D.

COLLINS, FREDERICK L. *Uncle Sam's Billion Dollar Baby.* New York: G. P. Putnam's Sons, 1945. 174 p. $2.50.

Private versus government ownership of public utilities has been long the subject of a bitter controversial dispute. To what extent shall the government go into business? Would it be better to have such business enterprises as power, telephones, telegraph, railroads, air lines, coal mines, gas, petroleum and so on government owned and operated as the mail is now? Or should all of these be left for private operation? There are many adherents on both sides. Russia represents one extreme and England has lately tended that way. Up to now, the United States has been the leading example of private ownership.

The government owned and operated side of the controversy is presented by Lilienthal's *TVA, Democracy on the March.*

More and bigger TVA's are advocated by the proponents of government ownership, and in the days ahead there will be many legislative battles fought over similar projects such as the Missouri, Arkansas, Wabash, Ohio and the present proposed $100,000,000 Sangamon Valley project.

Uncle Sam's Billion Dollar Baby presents the case for private ownership and maintains that the TVA instead of being an example of *Democracy on the March* is more aptly characterized as *Socialism on the March.* The people have been and are now being intentionally deceived by the propagandists of the TVA, says Collins. He contends, as is now admitted by the original advocates, that the TVA has not served as the original yardstick for determining the exact cost of power production through the use of government built and operated power dams.

The author seems to show quite conclusively that the original purpose of TVA for flood control has been transferred to that of power production. And that in this area the TVA is proving a costly social experiment. The author says that if the books showing the operating costs of the TVA were kept in the same manner as are the books of privately managed power companies, that instead of showing a handsome profit

(some twenty-five million dollars) they would show an even greater loss (some forty million dollars). The TVA pays no taxes (federal, state, county, or community) and has no interest cost assessed against it. Almost any business concern under these circumstance could take a nearly billion dollar plant and make it show a profit. Although Lilienthal claims that TVA will pay back to the government in fifty years all the costs of original construction, this is merely a pipe dream. The money will never be paid back. The author points out, too, that most so called privately owned power companies are really publicly owned through the many people who own most of the stocks. And in the case of flood control, many such projects costs more than they will benefit. Land above the dam is lost forever as a source of production and taxes and the benefits from flood prevention below the dam may be nominal because floods do not occur every year and are not always seriously damaging. Thus losses below the dam may not nearly equal the interest costs on dam construction, the loss in crop production and taxes on land, crops, and construction above the dam.

And one can but wonder if the series of labor disputes and strikes, spaced as they have been is not all a part of great plan to force government operation of many presently privately operated concerns. Has it been planned that way?

—C. L. D.

DAVIDOFF, HENRY. *A World Treasury of Proverbs.* New York: Random House, 1946. 526 p. $3.00.

The cover blurb says that this is "By far the most comprehensive collection of its kind to be gathered in a single volume, this conveniently arranged and classified treasury offers a distillation of the world's wisdom as expressed succienctly in its most memorable proverbs and sayings. There are more than 15,500 proverbs drawn from twenty-five languages and even more nations; each one is traced to its source and attributed to its national origin and to its author, if any. The organization of the book makes it possible to find any proverb by subject, alphabetically arranged, or by means of the index. *A World Treasury of Proverbs* is a book of endless discoveries, of sheer delight in the familiar and unfamiliar, and an invaluable work of reference. In its 526 pages are to be found the gems of thought that have sparkled through the ages." The reviewer agrees that the contents completely live up to this promise.

Under science we find—

Human science is uncertain. (Prior)

Much science, much sorrow.

Science is organized knowledge. (Spencer)

Science is the topography of ignorance. (O. W. Holmes)

The dismal science (i.e. economics). (Carlyle)

The science of fools with long memories. (i.e. heraldry)

The science of sciences. (i.e. philosophy)

Wonder is the seed of science.

Science is for those who learn; poetry for those who know. (French)

Science is nothing but perception. (Plato)

Science is nothing but good sense and reason. (Polish)

Science is a cemetery of dead ideas. (Unamuno)

Science is madness, if good sense does not cure it.

—G. E. D.

DE LEON, BENJAMIN. *The Story of the Thermometer.* Newark: (Box 8085) Clinton Hill Station: Science Learning Aids Publishing Company, 1946. 33 p.

Here is the first of a series of Lessons in Science for school and home study. It is a complete unit on the thermometer—origins, difficulties (in fixing scale, types of liquids, glass, etc.), and special thermometers (clinical, weatherman's, baker's, steel worker's, and astronomer's). There are numerous illustrations, test questions, class experiments, review questions, problems for discussion, suggestions for reading, writing, charts, or posters, and mathematical problems.

Science teachers will find this not only a well worked out science unit but a fine source of information. —S. M. A.

MOCK, ELIZABETH B. *If You Want to Build a House.* New York: The Museum of Modern Art, 1946. 96 p. $2.00.

This book combines a discriminating photographic survey of modern architecture with a simply written analysis of problems in home planning, designing and construction. The author discusses the advantages and disadvantages of modern design in terms of direct value to the prospective home builder. Although not a technical treatise on home-building, many questions that home-builders must face are answered. One hundred sixteen photographs supplement the textual material.

A prospective home-builder will find many useful ideas in this book. If a person can learn by reading and profit by that reading, those planning on building homes should read some of the many fine books on building houses and profit by the ideas they suggest. This is one of those books a prospective builder should not miss.

—C. L. D.

BENDURE, ZELMA, AND PFEIFFER, GLADYS *America's Fabrics.* New York: The Macmillan Company, 1946. 688 p. $10.00.

This is probably the most complete book that has been published on the more than a thousand American fabrics. It tells the story of every basic fabric including the modern synthetics: the origins, individual characteristics, and values of each, the different types of fabrics for which each

fiber can be used and the various finishes and dyes that can be applied to these fabrics. Every process in the manufacturing is clearly explained—the essential steps in producing the fiber, yarn making, the many kinds of weaving, knitting, and twisting, the finishing processes, the chemical and the dyeing processes.

There is information on standards, labeling requirements, testing, identification, and so on. The book is lavishly illustrated, largely with original photographs of representative samples. Technical and scientific accuracy has been assured by checking of authorities in the fabric and contributing chemical industries.

In addition to being a complete, reliable, and up-to-date source of information, there are hundreds of fascinating stories about the development of fabrics which has enlisted men's scientific genius and artistic talents, painstaking skills, labor and mechanical genius since before the dawn of history.

The senior author has had much experience as a merchandise manager in large department stores and at present is Director of the Retail Selling Division of the Fairchild Publications and Director of the Department of Merchandise Education of Good Housekeeping.

The literary style is that of the layman—even the technical, scientific aspects are in terms that most readers can grasp. All science teachers and any others interested in any aspect of fabrics will find here exactly the accurate information they would like and need to know. It is an unexcelled reference book for the teacher in home economics, general science, elementary science, consumer science, chemistry, or physical science survey. It is highly recommended for the secondary school library. —C. M. P.

CLIFFORD, WILLIAM KINGDOM. *The Common Sense of The Exact Sciences.* New York: Alfred A. Knopf, Inc., 1946. 249 p. $4.00.

This is the reprint of a book which first appeared in 1885. Its original purpose was to explain modern scientific and modern thought to the uninitiated. It serves the same purpose as adequately today. It will appeal not only to laymen but also to scientists and professional mathematicians. The original 130 diagrams have been completely redrawn and corrected.

A few of the subheadings of the five chapters are as follows: (1) Number: Number is independent of the order of counting, Square of $a+1$, on powers of $a+b$; (2) Space: Boundaries take up no room, the characteristics of shape, properties of triangles; (3) Quantity: The measurement of quantities, The addition and subtraction of quantities, Extension of the conception of area; (4) Position: All position is relative, Position may be determined by directed steps, On the bending of space; and (5) Motion: On the various kinds of motion, On the laws of motion, Of mass and force. —C. L. D.

The Radio Amateurs' Handbook. West Hartford, Connecticut: The American Radio Relay League, Inc., 1946. 480 p. $1.00.

This 1946 edition opens with a brief history of amateur radio and its future prospects. This is followed by nine chapters on "Principles and Design" which in reality is a text book covering the non-mathematical principles, theory and design of radio. In addition nine chapters are devoted to "Equipment Construction." This has been brought up to the latest types of amateur receivers, transmitters, antennas, and other needed equipment.

Six pages of diagrams show the bottom view and inside connection of more than 300 different receiving tubes and transmitting tubes. There are 17 tables giving complete data about all sorts of tubes.

There are some very helpful suggestions on memorizing the code and on acquiring speed. It is an excellent manual for use as a training text for either class or home study. There are 688 illustrations and an 11-page index.

—W. G. W.

AMERICAN SCIENTISTS. *Serving Through Science.* Washington, D. C.: National Science Teachers Association, 1946. 120 p.

This bulletin contains a series of short science talks by outstanding authorities in various fields of science. They were delivered over the radio during intermission of the New York Philharmonic Symphony radio concerts, sponsored by the U. S. Rubber Company.

Among the speakers were Compton, Langmuir, Harvey, Land, Sikorsky, Russell, Bowman, Mees, Urey, and Oppenheimer. The following are a few of the topics covered: Science and the Nation's Future; Unforeseeable Results of Research; Living Lights; Polarized Light; Direct Lift Aircraft; Are Planets Habitable?; The New Geography; Cows, Movies, and Color-Photography; Isotopes in Atomic Research; and The Atomic Age. —W. G W.

ELLIOTT, A. M. *Laboratory Guide for Animal Biology.* Minneapolis: Burgess Publishing Company, 1946. 274 p. $2.75.

This is a laboratory guide for teaching general zoology in colleges and universities. It is an "attempt to create interest for the general student yet in no way dilute subject matter for the preprofessional student that is generally accepted as fundamental" writes the author in his preface. Although the animals are treated in "phylogenetic sequence" this does not prevent a course being started with the frog if a teacher desires such a beginning. Numerous graphic illustrations made from microscopic studies and laboratory dissections illustrate the laboratory procedures, some of which are to be completed by the student himself. The guide is written with such specific directions as to procedures that it should serve

its real purpose to guide the student through his findings without too much help from the laboratory instructors. —G. O.

VAN METRE, T. W. *Trains, Tracks, and Travel.* New York: Simmons-Boardman Publishing Corp., 1946. 423 p. $3.50.

This is the seventh edition of the most popular book on trains that has ever been published. The author is an authority in this field and is Professor of Transportation at Columbia University.

Trains have been one of the most important factors in making the United States great, and the magnificent job performed by American railroads during World War II does much to enhance an already remarkable record. Most boys and many men are very much interested in trains. Rail fans, locomotive and train picture collectors, and men for whom railroading is a lost love of their youth will thoroughly enjoy this book.

Rare, authentic views of the pioneer era are shown along with some of the finest pictures of modern railroading. The reader is taken behind the scenes and shown how a railroad is built, how the trains are made up, how dispatchers put through fast passenger trains with the aid of high speed signaling and how passengers are made comfortable on transcontinental trips. Hundreds of pictures visualize the high spots in the text.

This is a recommended book for any boy, the general reader, the science teacher teaching units on transportation, and the economic geography teacher. —S. M. A.

GARRETT, EILEEN J., AND LAMARQUE, ABRIL. *Man—the Miracle Maker.* New York: Creative Age Press, 1946. 116 p. $2.50.

This is a pictorial record of man's inventiveness from fire to the atomic bomb. All of the important scientific developments the human race has achieved since the day man lighted his first fire are pictured and pertinently described. It shows what man has done with his knowledge, both constructively and destructively. The illustrations are as excellent as they are intriguing. In turn we see fire, gunpowder, the wheel, steam, the balloon, the automobile, the airplane, electricity, communication, medicine, radar, and the atomic bomb.

Modern man is not obsolete. Today there is still time to choose between a brilliant beginning or a dismal end. Man is still permitted to be the master of his own genius.

This is an excellent book for the science teacher, science student, and for the school library. —C. M. P.

MCKAY, HERBERT. *The World of Numbers.* New York: The Macmillan Company, 1946. 198 p. $2.50.

To the mathematician, mathematics has always been a stimulation and a delight, an intellectual entertainment of the highest order. Herein lies the fascination of mathematics for so many people. Not so to a majority of the rest of the people. All too often, it has been a subject to be avoided at all hazards. *The World of Numbers* shows how enjoyable (and romantic, too) mathematics can be—even to the laymen.

This is a recommended book for the mathematics teacher, the school library, and to any layman interested in the unusual.

If civilization had developed in the southern hemisphere, it is quite likely that most people would be left-handed, screws would turn in the reverse direction, and so on. He shows the absurdity of putting too great a reliance on data often found in books, atlases, etc.—such as the areas and heights of continents, the lengths of rivers, etc. Yet he shows how the erosion rate of shorelines, rivers, and continents, the volume of the oceans, the Amazon, etc., the wasting away of the sun, the distance to stars, the size and age of the earth, the stars, and the universe, have been estimated. There are three intersting chapters on the ghost quantity, poets numbers, and numbers that mean too much. —G. B. K.

FRANK, PHILIPP. *Foundations of Physics.* Chicago: University of Chicago Press, 1946. 78 p. $1.00.

This is one of a series of twenty monographs in a two-volume unit International Encyclopedia of Unified Science. This monograph attempts to present physics in such a way that it is fit to become a part of unified science. The major ideas discussed are, The Logical Structure of Physical Theories; Classical Newtonian Mechanics; Heat, Irreversibility, and Statistics; The Theory of Relativity; Light; Mechanics of Small Masses (Wave Mechanics); and, Structure of Matter.

Every physical theory consists of three kinds of statement: equations between physical quantities (relations between symbols), logical rules, and semantical rules (operational definitions). There has been much confusion when attempts have been made to fit physics into the structure of other fields of knowledge. Much of this has been caused by the fact that the operational definitions of the symbols have been omitted when physics has been introduced into such fields as biology, medicine, economics, sociology, theology, and so on. —C. L. D.

HILL, NAPOLEON. *Think and Grow Rich; How to Sell Your Way Through Life.* Cleveland: The Ralston Society, 1946. 381; 371 p. $2.00 each.

These books have been highly acclaimed by outstanding educational leaders, business men, and industrial leaders. Everyone will profit from their reading. In *Think and Grow Rich* the following steps are described in order: Desire, Faith, Auto-suggestion, Specialized knowledge, Imagination, Organized planning, Decision, Persistence,

Power of the Master Mind, The mystery of sex transmutation, The sub-conscious mind, The brain, and The sixth sense. The six basic fears of man are fear of poverty, criticism, ill health, loss of love of someone, old age, and death. Fifty-seven common alibis of Old Man If are listed.

The author lists seventeen principles of success: A definite major aim in life, self confidence, initiative, the habit of saving, imagination, enthusiasm, self-control, the habit of doing more than you are paid to do, a pleasing personality, accurate thinking, concentration of effort, co-operation, profiting by failures, tolerance, the golden rule applied, the habit of health and the master mind principle applied. —C. L. D.

SYMPOSIUM. *Battle Stations! Your Navy in Action.* New York: Wm. H. Wise and Company, Inc., 1946. 402 p. $3.95.

This is a photographic epic of the naval operations of World War II told by the admirals who sailed the fleet from Norfolk to Normandy and from the Golden Gate to the Inland Sea.

Innumerable photographs, many in color, most of them official U. S. Navy, comprise the bulk of the book. Authoritative articles implement the pictures, making this probably the most complete, certainly the most interesting, book on the American Navy in World War II. It is a record of which every American can well be proud.

Articles are as follows: Foreword by Fleet Admiral Ernest J. King; A Review of the History of the U. S. Navy; The Navy Trains for War; Pearl Harbor; Battle of the Atlantic; The Battle of Midway; Women in the Service (Navy Nurses, Spars, Marines, Waves); Victory at Guadalcanal; The Invasion of North Africa; The Invasion of Sicily; The Battle for Tarawa; The Capture of Kwajalein; The Invasion of Normandy; The Battle for the Marianas; The Battle of the Philippine Sea; The Invasion of Southern France; The U. S. Coast Guard in World War II; The Battle for Leyete Gulf; U. S. Naval Group, China; The Battle for Iwo Jima; The Okinawa Campaign; The Last Days of the Japanese Fleet; Surrender of Japan; Naval Awards of the Congressional Medal of Honor; Statistics on American, Jap, German, and Italian Navies; The Post War Navy; Ships of the Fleet; and Biographical Notes.

—R. J. A.

CARLETON, ROBERT H. *Vitalized Physics in Graphicolor.* New York: College Entrance Book Company, 1946. 378 p. $0.65.

Two-color technique is used throughout the text to make diagrams much more easily comprehended and to "spotlight" important ideas. Important equations and formulas are made to stand out by the contrast in colors. As the reviewer knows, students seem to like this sort of aid in learning and it has been very popular with them. They say they understand things much more readily.

The material here is rather compact, but well illustrated with more than 200 diagrams. Good motivation characterizes the textual material and it seems to be thoroughly up to date. It has been edited by Michael N. Idelson, head of the Department of Physical Sciences, Abraham Lincoln High School, Brooklyn. The author is head of the Science Department of the Summit, New Jersey, High School.

There are thought questions, objective tests and problems. Answers (printed in red) are given for all problems. Students will like this book even as supplementary to the regular classroom text, although this book serves admirably as a text itself. —C. M. P.

DES JARDINS, RUSSELL T. *Vitalized Chemistry in Graphicolor.* New York: College Entrance Book Company, 1946. 366 p. $0.65.

Vitalized Chemistry follows the same type of physical makeup and organization as *Vitalized Physics* reviewed above. It was edited by George C. Job, Departmental Supervisor of Science of the Albany, New York, Public Schools, and Theodore C. Sargent of the Swampscott, Massachusetts, High School, and President of the New England Chemistry Teachers Association. The author teaches chemistry in the Pierre S. Du Pont High School, Wilmington, Delaware.

After the more or less usual theoretical material, chemical elements and compounds, there are chapters on The Airplane Metals; The Protective Metals; Paints and Painting; How Chemistry Helps Man to Record His Thoughts and Actions; The Nature of Organic Chemistry; Foods, Drugs, and Cosmetics; and The Chemistry of Textiles and Plastics. This is an excellent text and a useful reference. —C. M. P.

ROBBINS, ANN ROE. *How To Cook Well.* New York: Thomas Y. Crowell Company, 1946. 748 p. $2.50.

Almost anyone can learn to cook well and it is almost as important for boys and men as for girls and women. This book presents the basic ideas and principles of all good cooking. One of the chief essentials in learning to cook well when following recipes is to know the more or less technical terminology. Good cooking is a great art and this book will enable many persons to attain that proficiency relatively easily. The book has about 1,000 recipes covering basic as well as special items. —R. J. A.

Clemensen, Jessie Williams, and LaPorte, William Ralph. *Your Health and Safety.* New York: Harcourt, Brace and Company, 1946. 592 p. $2.12.

If America learns from her war experience, health and education will assume a much greater role in the post-war school. We should have learned that lesson from World War I, but for several reasons we made only token progress in the period between World War I and World War II. Surely the results of the draft examinations in general revealed no conditions about which we could take great pride. While true that no other nation in history has been more concerned about its health than the United States, an adequate health and physical education program for most American schools is an ideal to strive for rather than a goal already attained. Our death rate from accidents is almost a national scandal. Surely it is time that the schools and other organizations should offer a really functional program in this area.

Your Health and Safety is an excellent text to serve as a basis for a health and safety course in the secondary schools. A basic minimum of physiology has been included because the authors deem it essential. The emphasis is upon *application* of health knowledge to improve daily living. The book is pre-eminently a science book. Physiology is the science; health is the practical application of that science.

Many attractive illustrations supplement the interestingly written textual material. This is a text pupils will enjoy. Each chapter begins with a useful study outline and concludes with a brief summary, a list of activities and suggested references. The appendix has a list of general references, special guides for teachers, laboratory manuals and workbooks, consumer education publications, and a list of motion pictures suitable for each chapter. —S. M. A.

Guinagh, Kevin. *Search for Glory.* New York: Longmans, Green and Company, Inc., 1946. 220 p. $2.50.

Kevin Guinagh has been interested in the history of aviation and *Search for Glory* is an outgrowth of this study which took him to France and other European countries to fill in the background for Pilatre de Rozier's story. Pilatre set out for Paris when he was nineteen and penniless with a resolve to become famous before he was thirty. "It was a youthful boast," he says in his final letter to Madame de Vie, his patroness and sweetheart. "Though great improvements are bound to come, thoughtful men will always remember that I made the first gas mask to protect sewer workers. This is more important than my work with balloons." Nevertheless, his experiments with hot-air balloons were a great success. Pilatre was a man of great charm. He was appointed to the court of Versailles and subsequently was made head of the King's Museum. Pilatre was a man ahead of his times. He believed that women should not be kept in ignorance concerning the marvels of nature. In *Search for Glory* the reader will enjoy a delightful story of people as well as a delightful narrative concerning man's attempt to fly at a time when even some scientists believed that "sane men will not think of tempting Providence by ascending into the heavens before they are summoned."

—G. O.

Fraser, Chelsea. *Heroes of the Air.* New York: Thomas Y. Crowell Company, 1945. 888 p. $2.50.

This standard and popular book on aviation is now in its nineteenth printing. It is a full and complete record of man's attempt to fly. This new printing includes eighty-nine maps drawn by the author. The opening chapter deals with flying, past and present, and the concluding chapter brings flying up to date in 1941 with the Atlantic life lines to Britain. The author has included an excellent chronology beginning in 1903 with the Wright brothers and carrying it through the events of aviation in 1941 giving the reader some idea of not only chronological events but a complete picture of who's who in flying. Here in this book one can read the account of Howard Hughes' trip around the world, Corrigan's hilarious "wrong-way flight," the British Pick-a-back Seaplane experiment, and the flights of the Clipper ships which fly between the United States and Europe. The stories are told in chronological order giving the reader an appreciation of the men and women who made history for us in these sensational journeys in the air. —G. O.

Montgomery, Elizabeth Rider. *Great Medical Discoveries.* New York: Robert M. McBride and Company, 1945. 257 p. $2.00.

Just as Elizabeth Rider Montgomery gave us the fascinating stories behind great inventions, she has given us here not only historical facts concerning great medical discoveries but has made the discoverer himself come alive with the story of his discovery. And yet the book is not just a story book. There are four parts to the contents of the book, the first dealing with internal medicine; the second with germ diseases; the third, surgery; and the fourth, with preventive medicine. The very titles of the chapters intrigue the reader to turn the pages and read; for example, "Extra Ears" is the story of the stethoscope; "Unsafety Pins," the bronchoscope; "Threat to Modesty," the X-ray; "Life in the Bank," the blood bank. The book opens with Dr. Will Harvey's theory concerning the circulation of the blood and ends with the story of the Russian professor, Sergius Yudin, and his assistant who proved that blood with sodium citrate

added to keep it from clotting could be uesd days later when stored at nearly freezing temperature. *Great Medical Discoveries* is the story of a war between Science and Suffering and the men and women whose research and observation made victory possible. —G. O.

CRAWFORD, ALBERT BEECHER, AND BURNHAM, PAUL SYLVESTER. *Forecasting College Achievement. Part I. General Considerations in the Measurement of Academic Promise.* New Haven: Yale University Press, 1946. 291 p. $3.75.

This is the first part of a three-volume series, the first comprehensive statement of general principles in measurement and guidance at the college-preparatory and freshman levels. It surveys progress in the evolution of prognostic measures and offers the layman a simplified outline of basic statistical concepts. Tests of general intelligence of achievement in specific fields, of unitary traits or primary mental abilities are discussed as background materials essential to the evaluation of aptitude tests (defined as those of "relative readiness-to-learn").

Chapter headings are, Background of Educational Measurements, The Measurement of Educational Performance and Basic Statistical Principles, Differential Attitude and General Intelligence Tests, Achievement Testing, A Sample Aptitude Battery, Unitary Traits and Primary Abilities, and Test Construction and Measurement of "Idiosyncrasies." The appendix contains a practice Booklet (Yale Battery), tables supplementary to the data of Chapters V and VI, and references and author index.

This is an excellent book for all teachers interested in testing and guidance, which should just about include every college of education teacher, all teachers interested in problems of guidance and testing, as well as many special subject matter teachers both on the secondary and college level. —C. L. D.

COOK, ROBERT C., AND BURKS, BARBARA S. *How Heredity Builds Our Lives.* Washington: American Genetics Association, 1946. 64 p. $0.75.

This is one of the finest short treatises on heredity that the reviewer has happened across. It is a popular introduction to human genetics and eugenics by Mr. Cook, Managing Editor of the *Journal of Heredity,* and the late Dr. Burks, Associate in Psychology, Columbia University. There are a number of photographs and several drawings by Clyde E. Keeler, head of the Department of Biology, Wesleyan College, Macon, Georgia.

Chapter headings are: Living Building Blocks, Unravelling Heredity and Environment, What Environment Can Do, and Looking at Life Eugenically.

This is an excellent publication for the biology teacher, high school biology student, elementary science teacher, and anyone wanting an easy to read, understandable, authoritative insight into the problems of heredity and environment.

—C. M. P.

BRILL, A. A. *Lectures on Psychoanalytic Psychiatry.* New York: Alfred A. Knopf, Inc., 1946. 302 p. $3.00.

The material contained in this book was given in the form of lectures at the New York Psychiatric Institute from 1926 to 1942. It formed part of a post-graduate course in neurology and psychiatry. The object of the course was two-fold: (1) to give a brief review of the theories and practices of psychoanalysis as developed by Freud; and (2) to apply these theories to the descriptive psychiatry as developed by Kraepelin and others, abroad and in this country.

Altogether the treatise provides a clear and simple explanation of the history, meaning and application of psychoanalysis, enlivened and illuminated by significant case histories from Dr. Brill's own experience. Dr. Brill, born in Austria, attended the College of the City of New York, New York University, and has an M.D. degree from Columbia. For many years he translated many of the writings of Freud into English for publication in this country.

This is an interesting book for anyone to read, teachers and laymen. Much of the excellence and value of this book lies in the fact that it deals with fundamental principles. Certainly psychiatry has made tremendous gains in recent years, especially during the war period. In the postwar period it will probably assume an even greater importance as veterans find the task of adjustment presenting almost (to them) insurmountable problems. —G. E. D.

WOELLNER, ROBERT C., AND WOOD, M. AURILLA. *Requirements for Certification of Teachers and Administrators.* Chicago: University of Chicago Press, 1946. Unpaged. $2.25.

This is the eleventh edition bringing state certification requirements for elementary schools, secondary schools, and junior colleges up to date. Recommendations of regional and national associations are also given. States are listed alphabetically and specific requirements are listed.

Much valuable and often difficult to get information is given in this useful compendium.

—C. M. P.

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